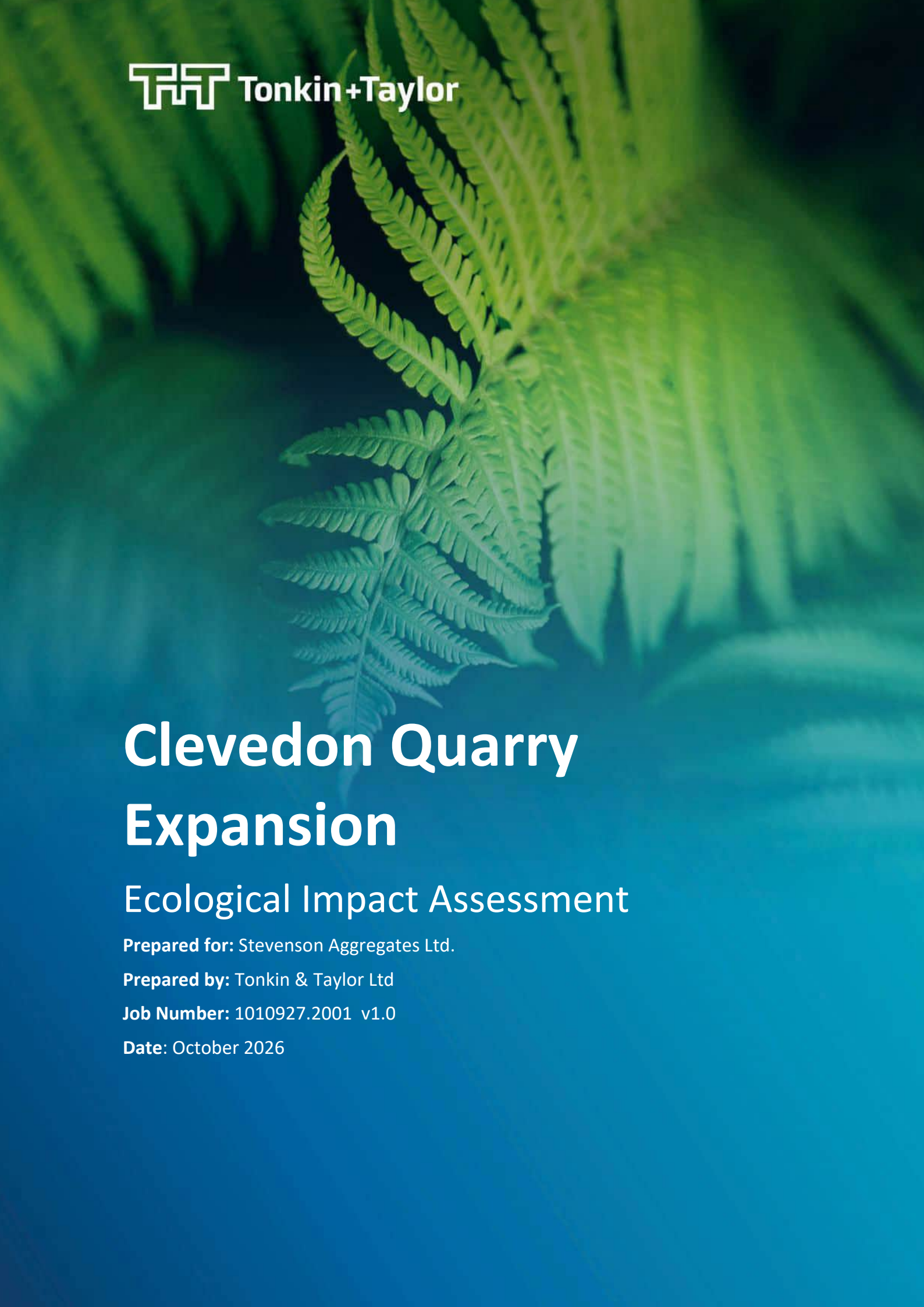


Clevedon Quarry Expansion

Ecological Impact Assessment

Prepared for: Stevenson Aggregates Ltd.

Prepared by: Tonkin & Taylor Ltd

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Quality management

To ensure alignment with our Quality Management System, technical review of differing elements within this report is documented below.

Quality management

Element	Prepared by	Reviewed by
Terrestrial	J. MacKay	J. Markham
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Executive summary

Introduction

Clevedon Quarry is a regionally significant source of aggregate located within the Hunua Ecological District, on the north-western edge of the Hunua Ranges Regional Park, Auckland. The quarry is owned and operated by Stevenson Aggregates Ltd (SAL), a subsidiary of Fulton Hogan, which acquired the site in April 2016. SAL holds an existing resource consent granted in 2018 (BUN60302442) authorising the expansion of the quarry to extract approximately 60 million tonnes of aggregate. SAL is now seeking consent under the Fast-track Approvals Act (FTAA) for an alternative staged expansion of the quarry ('the project') that would provide access to additional aggregate resources. This Ecological Impact Assessment (EcIA) provides a technical assessment of the ecological values of the site and assesses the effects of the project on these values, as well as measures proposed to address adverse ecological effects.

Project Description

The project will be undertaken in five indicative stages over an estimated 50-year period, achieving a maximum excavation depth of approximately RL 22.5 m and a final quarry footprint of approximately 74 ha. A 4.6 ha Overburden Disposal Area (OBDA) will be located in a gully east of the existing quarry footprint. The quarry expansion footprint spans four catchments (Streams 1, 2, 2a and 3) which each drain to the Wairoa River, located to the west of the site. The adverse ecological effects have been minimised through a multi-disciplinary design process. Key avoidance outcomes include:

- Selection of an OBDA location with no wetland or native forest habitat present.
- Repositioning of the southern quarry boundary to avoid native treeland and minimise impacts on Stream 3 headwater tributaries
- Reduction of the expansion footprint within the regenerating tree fern/broadleaf forest to avoid direct stream impacts.
- Avoidance of direct effects on the main channel of Stream 1, which has been assessed as having high ecological value.

Three iwi groups have expressed an interest in the project and mana whenua input has been incorporated into the design, including a preference for native species planting in all offset and compensation areas.

Assessment Methods

A combination of desktop review and comprehensive field investigations was undertaken to assess ecological values across the site. Desktop sources included publicly available databases (iNaturalist, eBird, NZ Plant Conservation Network Database, DOC bat database, NZ Freshwater Fish Database, Auckland Council herpetofauna databases, DOC herpetofauna atlas), Auckland Council GIS layers (Significant Ecological Areas, ecosystem type layers, overland flow paths), and previous ecological assessments prepared for the 2018 consent and 2024 Private Plan Change (PC89). Field assessments were completed across 27 site visits between March 2025 and August 2026 by experienced ecologists. Terrestrial methods included walk through surveys, quantitative vegetation plots, UAV/drone photography, 5-minute bird counts, lizard surveys through manual searching and nocturnal spotlighting, acoustic bat monitoring, and targeted eDNA sampling and habitat surveys for Hochstetter's frog. Freshwater methods included stream classification using a hybrid field and GIS-based approach, Stream Ecological Valuations (SEV) and macroinvertebrate sampling at representative reaches across all four catchments, and eDNA surveys within each catchment for fish species detection. Effects were assessed following the EIANZ Ecological Impact Assessment

Guidelines (EcIAG), with terrestrial residual effects quantified using the Biodiversity Offsets Accounting Model (BOAM) and freshwater residual effects quantified using the SEV/Environmental Compensation Ratio (ECR) methodology and.

Ecological Characteristics and Values

Terrestrial: Four vegetation types have been mapped within the impact area. Regenerating tree fern/broadleaf forest (6.1 ha) occurs in the northern extent of the site within a Significant Ecological Area (SEA_T_5588) and has been assigned a **high** ecological value. The remaining 58 ha of impact area comprises lower-value vegetation: cutover pine (55.4 ha, **negligible** value), tree privet-kānuka treeland (0.5 ha, **low** value), and exotic shrubland (2.0 ha, **low** value). Two areas of higher-quality native vegetation outside the impact area are present within the Stream 3 catchment outside of the impact area. King fern (nationally and regionally At Risk – Declining) has been recorded within the impact area and within mixed broadleaf forest outside of the impact area. Thirteen native bird species were recorded at or near the site. No native lizards were detected despite suitable habitat being present, likely due to a long history of site disturbance and lack of connectivity to source populations. Potential habitat for Hochstetter's frogs (At Risk – Declining) is present in reaches of Stream 1 and the southern tributary. Hochstetter's frogs were detected in eDNA surveys of Stream 1, but not detected in the southern tributary. Long-tailed bats (Threatened – Nationally Critical) were confirmed present throughout the site, with foraging activity recorded site-wide; one low-quality potential roost tree was identified within the impact footprint.

Freshwater: Four catchments were assessed: Stream 1, Stream 2, Stream 2a, and Stream 3. The Stream 1 main channel is a permanent, hard-bottomed first-order stream assessed as having **high** current ecological function. Streams 2 and 2a are first-order, soft-bottomed and intermittent in the upper catchment and hard-bottomed and permanent in the lower catchment. The Stream 3 main channel is a permanent second-order, hard-bottomed stream. In general, Streams 2, 2a and 3 have been assessed as having **moderate** current ecological function values due to the impacts of forestry activities. Reaches of all three streams that flow through areas of native/exotic regenerating bush have **high** current ecological function values.

Stream 1 has been assessed as having **very high** species value, supporting species including longfin eel, banded kōkopu, torrentfish, and redfin bully. Stream catchments 2 and 2a support smaller fish assemblages dominated by eels and banded kōkopu, likely due to downstream artificial fish passage barriers and limited habitat availability, and species values are **high** and **low,** respectively. Stream 3 is well-connected to the Wairoa River and supports the most diverse fish assemblage of the four catchments, including inanga and torrentfish, and is assigned **high to very high** species value. Macroinvertebrate communities generally indicated good to excellent stream ecological health across the catchments, with the exception of intermittent tributaries where poor indices reflected high sediment loading. The Wairoa River is within a catchment heavily modified by agricultural land use, but supports a diverse fish community. It is assessed as having **moderate** ecological function value and **very high** freshwater fauna value. Potential freshwater ecological values for each catchment are not expected to increase further than their current values, with the exception of the upper catchment of Stream 1 that is within SEA-designated vegetation and with headwaters outside of the existing quarry footprint.

Assessment of Terrestrial Effects and Effects Management

The potential adverse effects on terrestrial habitats and fauna have been identified as:

- Permanent loss of vegetation.
- Edge effects on native vegetation outside of the quarry footprint.
- Loss of 'At Risk-Declining' king fern.
- Injury or mortality of native fauna.

- Disturbance of native fauna.

The magnitude of effect of vegetation clearance has been assessed as **moderate**. Cutover pine (55.4 ha), tree privet-kānuka treeland (0.5 ha), and exotic shrubland (2.0 ha) vegetation types have been assigned an ecological value of negligible to low, and effects management is recommended for the loss of these vegetation types. The regenerating tree fern/broadleaf forest within an SEA overlay has been assigned an ecological value of high leading to an overall level of effect of **high**. The loss of 6.1 ha of this vegetation cannot be avoided, and an ecological offset is recommended to address residual ecological effects.

The overall level of effect of edge effects on retained native vegetation at the newly created quarry footprint margin is assessed as **very low** given the pioneer nature of the SEA vegetation community and the quantum of similar vegetation in the immediate vicinity of the site. No effects management is recommended to address edge effects. Adverse effects on king fern plants within the impact area will be reduced by transplanting individuals where practicable to nearby suitable habitats leading to an overall level of effect of **low**.

Injury and mortality of native birds will be avoided by scheduling clearance outside the peak breeding season (September–January inclusive); where this is not possible, pre-clearance nest checks will be undertaken. Implementing these management measures leads to an overall level of effect of **very low.** For long-tailed bats, tree removal protocols will be implemented during vegetation clearance leading to an overall level of effect of **very low**. Pre-clearance nest check and tree removal protocols will be detailed in fauna management plans and given the long duration of the project, management plans will be updated prior to each stage of vegetation clearance to incorporate current best practice at the time of clearance.

Disturbance effects from quarry noise and lighting on bats and birds can be appropriately managed leading to an overall level of effect of **very low** to **low**, noting that acoustic surveys demonstrate the local bat population has adapted to the existing quarry disturbance regime. Potential reduced baseflows in the southern tributary of Stream 1 may reduce Hochstetter's frog habitat quality; this effect is addressed through augmentation of the main stem of Stream 1.

Assessment of Freshwater Effects and Effects Management

The proposed expansion will result in the removal of a total of **2,392 m** of permanent and intermittent stream across four catchments: 344 m within Stream 1, 1,333 m within Stream 2, 78 m within Stream 2a, and 637 m within Stream 3. The magnitude of effect is assessed as **very high**, with a corresponding **high** to **very high** overall level of effect that cannot be remedied at the point of impact; residual effects are therefore addressed through freshwater offsetting and compensation. Freshwater fauna injury and mortality will be managed through a Freshwater Management Plan (FMP) providing for pre-disturbance fish salvage and relocation, reducing the overall level of effect to **very low** to **low**.

Changes to stream flows will result from:

- Loss of contributing catchment area, which is expected to reduce some headwater reaches below the 1.4 ha intermittent flow threshold (a **high** magnitude of effect that cannot practically be mitigated at the point of impact, resulting in an overall **moderate** to **very high** overall level of effect on 1,533 m of intermittent and permanent stream, to be addressed through residual effects management measures)
- Groundwater drawdown modelled to deplete stream baseflows by 18–91% across various sub-catchment segments at Stage 5. Augmentation is proposed to maintain baseflows in the Stream 1 main channel, the Stream 1 southern tributary, and the Stream 3 upper main channel, reducing the magnitude of effect on these reaches to **low**.

Residual effects management measures will address other affected reaches including the downstream remnant of Stream 2, which will lose up to 92% of its upstream contributing catchment, is assessed as having a **moderate** to **very high** overall level of effect.

Sediment discharge and deposition during earthworks and instream works will be managed in accordance with GD05 erosion and sediment control principles and an upgraded Water Management System (WMS) incorporating settlement sumps and a constructed treatment wetland, reducing sediment effects to a **negligible** to **low** magnitude of effects across all receiving environments and corresponding **very low** and **low** overall level of effect. Water quality of water used for augmentation will be governed by the ARMP, reducing this effect to **low** for Streams 1 and 3, with an overall **low** level of effect, and a **negligible** magnitude of effect with **very low** and **low** overall level of effect for the Wairoa River. The potential for stream channel scour and erosion due to discharge of quarry runoff and augmented flows will also be managed by the ARMP, reducing the magnitude of effect to **negligible**, resulting in an overall level of effect of **very low**.

Residual Effects Management

Residual ecological effects that cannot be avoided, minimised, or remedied will be addressed through restoration planting within the Stream 3 catchment, immediately south of the quarry footprint. The overall goal of the restoration is to provide a fully forested corridor linking the Wairoa River to the Hunua Ranges and this catchment is considered the most appropriate location because it is close to the impact site, contains comparable terrestrial and freshwater habitats, and includes existing mature native forest and treeland that can provide seed sources for future natural regeneration.

Terrestrial offset: Two BOAM models were developed. BOAM1 determined that planting the full 4.6 ha OBDA (planting to occur once filled, approximately 10 years post-consent) is sufficient to offset 2.0 ha of regenerating tree fern/broadleaf forest. BOAM2 determined that an additional 6.0 ha of slope and open-area planting within the Stream 3 catchment (to be undertaken within 1 year after commencement of consent) is sufficient to offset the remaining 4.1 ha. In total, **10.6 ha** of restoration planting is proposed to offset the loss of 6.1 ha of regenerating tree fern/broadleaf forest. This planting will result in a net gain in ecological values.

Freshwater offset and compensation: Riparian planting within 20 m wide margins on both banks of 4,510 m of permanent and intermittent stream within the Stream 3 catchment (4,420 m² streambed area, and approximately 16.6 ha of planting) is proposed as the primary freshwater offset, addressing approximately 38% of the total stream loss effects. The remaining 62% (comprising 445 m² of unaddressed stream loss and a further 744 m² of residual flow-change effects) will be addressed through freshwater compensation planting totalling approximately 40.4 ha across the Stream 3 catchment. This compensation also addresses the potential effects of reduced stream flows on intermittent tributaries of the upper Stream 1 and 3 catchments.

The total restoration package of 67.6 ha of restoration planting will establish a ‘river to ridge’ forested corridor, providing potential future habitat for freshwater fauna, long-tailed bats, native birds, Hochstetter's frog, and king fern. All planting will be monitored for a minimum five-year establishment phase under the Ecological Management Plan (EMP) attached to the substantive application, with assessment against the BOAM and SEV targets recommended.

Summary and Conclusion

The Clevedon Quarry expansion will result in unavoidable adverse ecological effects, including the permanent loss of 6.1 ha of high-value regenerating native forest, 2,392 m of stream habitat across the four catchments, and changes to stream flows and groundwater in those four catchments. Through iterative design avoidance, best-practice effects management, and a substantial residual effects management package providing 67.6 ha of restoration planting within the Stream 3

catchment, adverse effects can be appropriately addressed in accordance with the principles of the NPS-IB and the NPS-FM. The residual effects management package is proportionate to the scale and nature of the ecological impacts and is consistent with mana whenua preferences for a native vegetated corridor linking the Wairoa River and the Hunua Ranges.

1 Introduction

Clevedon Quarry is a regionally significant quarry contributing to regional aggregate demand. Fulton Hogan purchased the Quarry in April 2016. It was later transferred to Fulton Hogan's subsidiary, Stevenson Aggregates Ltd (SAL) in 2019.

SAL holds an existing consent granted in 2018 (referred to as 'the 2018 Consent', BUN60302442)[1] which authorised the expansion of Clevedon Quarry to enable the extraction of approximately 60 million tonnes of aggregate and overburden, at an annual extraction rate of up to 3 million tonnes per year.

SAL is now seeking consent under the Fast-track Approvals Act (FTAA) for an alternative staged expansion of Clevedon Quarry ('the project')[2]. The proposed expansion would provide access to additional aggregate resources and enable a more efficient and practical quarry design than the layout authorised by the 2018 Consent. The expansion area is to be approximately 74 ha in total area and will yield approximately 150 MT of aggregate cumulatively across five indicative stages, over approximately 50 years.

This Ecological Impact Assessment report has been prepared to accompany the FTAA application and has been undertaken in accordance with our Letter of Engagement dated 4 November 2024 (T+T ref 1010927.2001) and subsequent Variation Orders.

1.1 Report scope

This EcIA provides a technical assessment of the ecological values of the site and assesses the effects of the project on these values, as well as recommendations to address adverse ecological effects.

1.2 Geographical and ecological context

Clevedon Quarry is within the Hunua Ecological District (ED), on the north-western edge of the Hunua Ranges Regional Park (Figure 1.1). Based on Auckland Council GeoMaps data, prior to the arrival of humans, the site would have been densely forested with tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13, Singers et al (2017)). Remnants of this forest type are present in amongst planted pine to the east of the site, with larger areas present in the centre of the Regional Park. The quarry is located in the mid to upper Wairoa River catchment, approximately 18 km inland from the Tāmaki Strait within the Hauraki Gulf. At its confluence with the Tāmaki Strait, the Wairoa River has a catchment area of 260 km^2, making it one of the Auckland Region's largest catchments. The headwaters and tributaries of the upper catchment originate in the Hunua Ranges which features extensive indigenous landcover, while land use in the mid to lower catchment is predominantly agriculture.

[1] [2018] NZEnvC 96.

[2] The consent package comprises new resource consents for the proposed expansion, together with a variation to the existing consent.

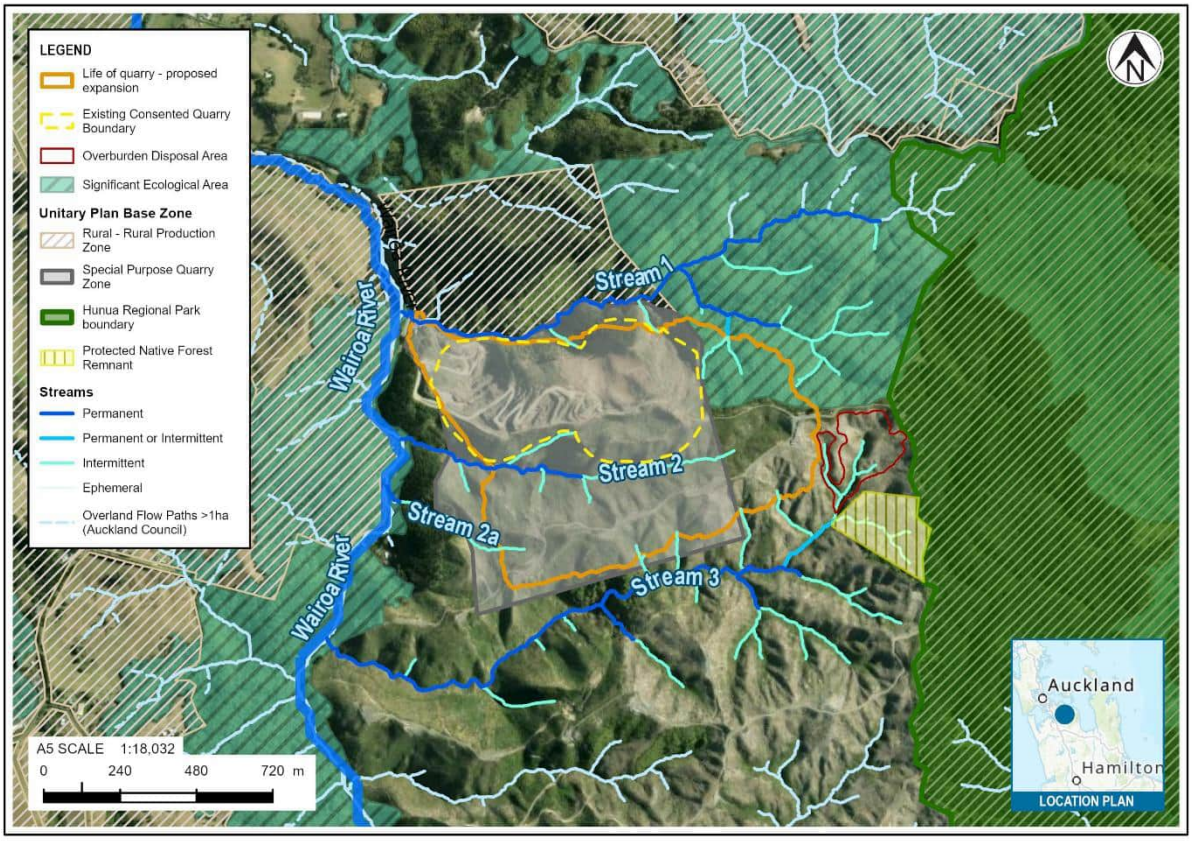


Figure 1.1: Site context

Away from the active quarry, most of the site comprises recently felled and re-planted pine forest with some areas mapped as kānuka scrub/forest (VS2), broadleaved species scrub/forest (VS5), and a small fragment of taraire, tawa, podocarp forest (WF9). Most of the VS2 vegetation is within an Auckland Unitary Plan Significant Ecological Area (SEA, SEA_T_5588) overlay. The fragment of WF9 forest is not within the SEA overlay; however, it is protected under a Consent Notice[3] registered against the site's Certificate of Title[4] that requires the native bush to be protected and maintained. This area is shown in Figure 1.1and is referred to as the "protected native forest remnant" for the remainder of this report.

In its current extent, Clevedon Quarry is bound by McNicol Road to the west, which runs adjacent to the Wairoa River, and by tributaries of the Wairoa River to the north (Stream 1) and south (Stream 2) of the quarry (Appendix A Figure 1). The quarry catchment is steep and incised by small headwater tributaries, predominantly located within the felled or recently replanted pine forestry area as described above. Cosseys Reservoir, a large water storage reservoir in the Hunua Ranges, is located approximately 2 km southeast of Clevedon Quarry and is partially fed by a tributary to the east of the quarry.

1.3 Statutory and project context

While this is a technical EcIA report, there are statutory matters which are relevant to the ecological assessment. These are identified at a high level in this section and are referred to where relevant within this EcIA.

[3] Pursuant to Section 221(1) of the Resource Management Act 1991.
[4] Certificate of Title NA105B/560 as Instrument D046071.8 (dated 16 September 1996).

- The Auckland Unitary Plan (AUP) is a single comprehensive plan for the Auckland Region. Intermittent and permanent streams are subject to the provisions of the AUP and the relevant stream definitions from the AUP have been used in this assessment (Section 3.2.2.1). AUP definitions and provisions relating to Significant Ecological Areas (SEAs) have been used in this assessment.
- National Policy Statement for Indigenous Biodiversity (NPS-IB) (Ministry for the Environment, 2023b). Alongside the policies and objectives of the NPS-IB, there are some specific definitions that are relevant to this assessment, including:
  - Effects management hierarchy.
  - Biodiversity offset and associated principles in Appendix 3.
  - Biodiversity compensation and associated principles in Appendix 4.
- National Policy Statement for Freshwater Management (NPS-FM) (Ministry for the Environment, 2024). Alongside the policies and objectives of the NPS-FM, there are some specific definitions that are relevant to this assessment, including:
  - Effects management hierarchy.
  - Biodiversity offset and associated principles in Appendix 6.
  - Biodiversity compensation and associated principles in Appendix 7.

The majority of the proposed life of quarry extent (approximately 59 ha) is located within the Special Purpose Quarry Zone (SPQZ), which anticipates the use of this area for quarrying activities. The remaining extent (approximately 15 ha) is located within the Rural Production Zone (RPZ).

Clevedon Quarry has been operating for over 50 years. The long-standing operation of Clevedon Quarry, the Site's underlying Special Purpose – Quarry Zone (SPQZ) zoning, and the suite of existing resource consents demonstrate that quarrying is the established and anticipated primary land use across the area subject to the quarry expansion. This is reflected in the planning framework, which provides for quarrying activities to ensure that demand for minerals can be met, and significant resource can be extracted. Refer to the accompanying AEE for further detail.

SAL now hold several consents relating to the operation and expansion of Clevedon Quarry that form part of the existing environment. The AEE summarises the existing granted SAL resource consents, but in particular and of relevance to this EcIA, are:

- the 2018 Consent (bundled consent BUN60302442). which currently authorises the quarry's key operational parameters and associated ancillary FoH activities; and
- the 'Outstanding Natural Features (ONF) consent' (LUC60361560 which approved widening an existing haul road within the ONF.

To enable the Clevedon Quarry Expansion, approvals are sought under the Resource Management Act 1991 (RMA)[5]. The consent package comprises new resource consents for the project, together with variations to two existing consents.

The Quarry Expansion consent will comprise the following:

- A new land use consent for mineral extraction activities and associated works within the proposed Quarry Expansion area (where required, this is specifically referred to as the 'mineral extraction consent').
- A new suite of regional consents, which will authorise the regional activities required across the Project extent, including activities associated with the LoQ footprint and supporting ancillary infrastructure.

[5] FTAA, s 42(4)(a) and 42(4)(b).

In parallel, SAL seeks variations to two existing consents referred to as 'Section 127 – variation to reduce scope of 2018 Consent' and 'LUC60361560 consent variation – relocation of ONF Planting Areas'.

Conditions of the 2018 Consent relating to vegetation clearance, lizard management, long-tailed bat management and stream monitoring are proposed to be removed from the 2018 Consent. In brief, these conditions are:

- Conditions 50 and 51, which require the planting of 600 m² of native vegetation along the true left riparian margin of the northern stream in accordance with an approved planting plan.
- Conditions 52–55, which require the preparation and implementation of a Herpetofauna Mitigation Plan for the removal of 600 m^2 of kānuka shrubland, are proposed to be removed.
- Conditions 56–58 of the 2018 Consent require the preparation and implementation of a Long-tailed Bat Management Plan in relation to the removal of mature pine trees associated with the approved 2018 quarry expansion.
- Conditions 57–59 require biological monitoring of permanent reaches of the North and South Streams to assess potential effects associated with the 2018 quarry expansion.

These matters will instead be addressed through the proposed Quarry Expansion consent. As a result, the effects arising from activities authorised by the varied 2018 Consent will either remain unchanged or be reduced. Refer to the AEE for further details.

2 Project description

2.1 Overview

The existing Clevedon Quarry is located entirely within 546 McNicol Road, Clevedon. The quarry sits within a wider area owned by SAL, encompassing approximately 544 ha (the 'SAL landholdings', refer to AEE for more information). Existing land types/uses within the SAL landholdings include quarrying, plantation forestry (recently felled and replanted), and areas of native vegetation.

Based on current supply, over the past couple of years, Clevedon Quarry has extracted approximately 200,000 – 300,000 tonnes of aggregate annually. SAL holds an existing consent granted in 2018 (referred to as 'the 2018 Consent')[6], authorising the expansion of the quarry to enable the extraction of approximately 60 MT of aggregate and overburden at an annual extraction rate of around 3 MT per year. SAL proposes an alternative staged expansion of Clevedon Quarry that delivers additional resource access and a more efficient, practical quarry design than the 2018-approved design.

2.2 Staging

The proposed quarry expansion would be undertaken in five indicative stages (Figure 2.1) over an estimated 50-year period, with a maximum excavation depth of approximately RL 22.5 m. The proposed Life of Quarry Extent is approximately 74 ha, excluding an approximately 4.6 ha Overburden Disposal Area (OBDA) (Appendix A Figure 1). The timing and sequencing of the stages is indicative only and may vary over the life of the quarry.

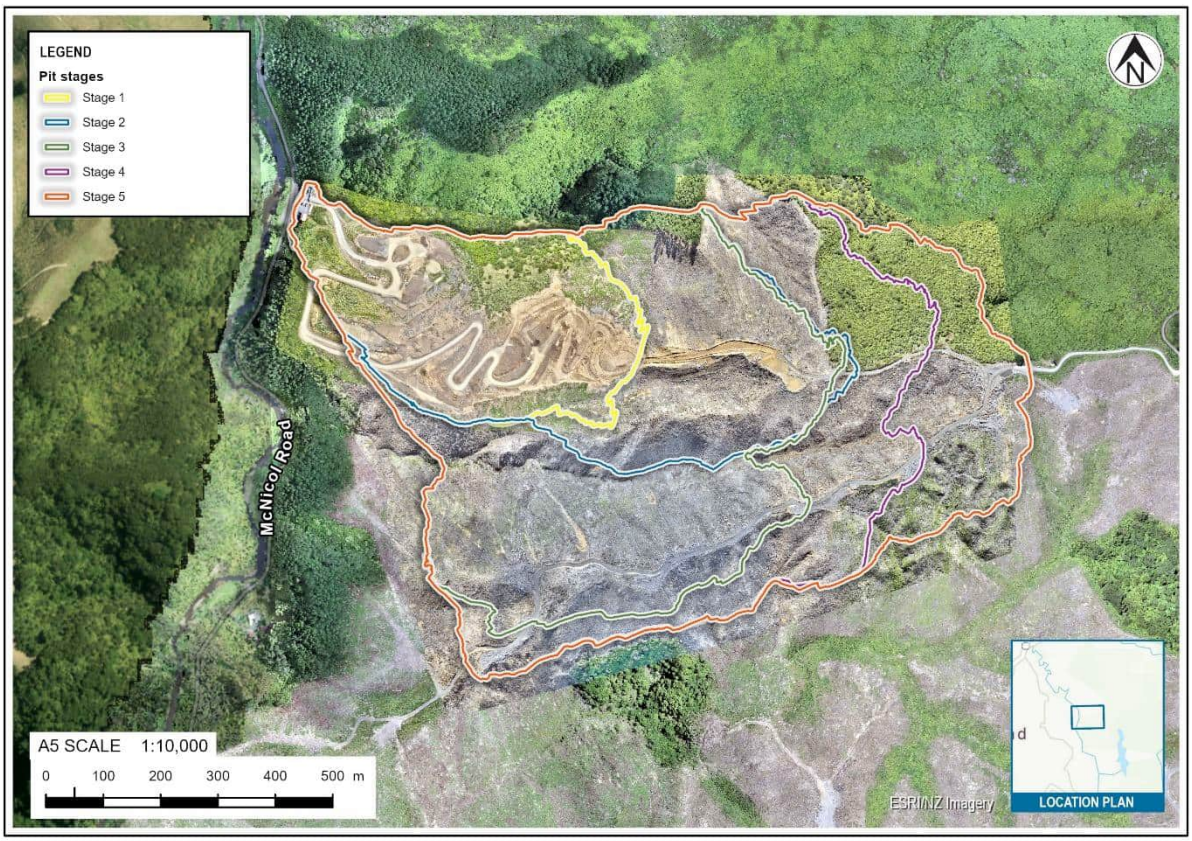


Figure 2.1: Overview of quarry expansion and indicative staging.

[6] [2018] NZEnvC 96.

Stage 1 (Years 0-10) would involve establishing access to the OBDA in the eastern part of the site, overburden removal, and the initial expansion of quarrying. Stages 2 and 3 (Years 10–30) would involve the progressive expansion of the interim quarry footprint.

Stage 4 (Years 30–40) would primarily involve quarry expansion into the Rural Production Zone (RPZ). As with Stages 1 to 3, quarry expansion would occur incrementally as the resource is extracted. Internal access roads would also be constructed progressively as the quarry expands.

Stage 5 (Years 40–50) reflects the anticipated quarry footprint at the end of the 50-year assessment period. The final quarry footprint is expected to be approximately 74 ha. Of this, approximately 59 ha, or around 80 %, would be located within the SPQZ, and approximately 16 ha, or around 20 %, would be located within the RPZ.

Works at the proposed OBDA are estimated to be completed within approximately 10 years, by the end of Stage 1. Once full, the OBDA will be available for planting as part of the offset package for the quarry expansion (see Section 7).

2.3 Avoidance and minimisation of effects through design

The proposed quarry footprint expansion and overburden footprints have been designed in an iterative process involving multiple specialists including ecologists, engineers, designers, and landscape architects. Multiple design options were considered and feedback from relevant specialists provided to SAL. During this process, actions were taken to avoid or minimise adverse ecological effects, including:

- Multiple locations were considered for overburden disposal. Following further investigation, some locations were discounted because they would have required reclamation of wetlands and loss of additional stream length. The proposed location is a gully close to the expansion footprint where there are no wetlands or native vegetation.
- The southernmost extent of the quarry footprint boundary was reduced and moved further north, closer to the existing consented footprint. This avoided native treeland and reduced the extent of direct impacts of Stream 3 headwater tributaries.
- The expansion footprint within the regenerating tree fern/broadleaf forest was reduced to avoid direct impacts on streams, including those that may provide frog habitat.
- All expansion designs avoided directly impacting the main channel of Stream 1 due to its high ecological value.

2.4 Mana whenua input into design

SAL have actively sought consultation with and maintained relationships with mana whenua. Of the nine iwi groups notified regarding the project, three have expressed an interest, with SAL engaging with these three parties and Cultural Impact Assessments are expected from one of these iwi. Key outcomes from this partnership include setting back the quarry expansion extent from the northern stream to avoid and minimise potential adverse effects on Stream 1. Avoiding where practicable, otherwise minimising the expansion into the SEA to the west, whilst balancing the requirements to achieve a safe quarry design. The result of this is provides a wider set back from the Stream 1, avoiding impacts on frog habitat and reducing loss of SEA and reclamation of streams.

Further feedback requested that offset and compensation planting areas be planted in native vegetation. This has been incorporated into the project design, particularly through the provision of offset planting. Iwi also expressed a preference for mitigation, offset and compensation planting to be undertaken onsite and as close as practicable the impact area.

3 Assessment methods

A combination of desktop and field ecological assessments have been undertaken by Tonkin & Taylor Ltd (T+T) to determine the ecological values of the area within the proposed life of quarry boundary and the OBDA (collectively, "the impact area"). The assessments also cover the Stream 3 catchment to the south, which includes areas proposed for terrestrial and freshwater offset and compensation (Appendix A Figure 1). The proposed impact area and proposed offset area are referred to collectively as "the site".

3.1 Desktop review of available information

3.1.1 Publicly available information and databases

Publicly available information and databases were reviewed to inform the methodology and approach to the ecological assessment and to establish the ecological context of the site. This included a review of the following available information:

- Indigenous terrestrial and wetland ecosystems of Auckland7.
- Auckland Council geographic information system (GIS) layers:
  - Significant ecological areas (SEAs);
  - Current and potential ecosystem type layers;
  - Overland flow paths;
  - Mapped wetlands; and
  - Permanent rivers or streams.
- New Zealand Plant Conservation Network Database (NZPCND, accessed 6 November 2025).
- iNaturalist database (https://iNaturalist.org, accessed 6 November 2025) (iNat).
- Bat records from the New Zealand bat distribution database (DOC, version dated August 2026).
- eBird database (https://ebird.org, accessed 22 October 2025).
- Auckland Council Herpetofauna Database (updated 19 September 2025) and DOC NZ Herpetofauna Atlas Database (updated 1 April 2026).
- Mollusca (snail) database (https://mollusca.co.nz, accessed 12 December 2024).
- New Zealand Freshwater Fish Database (https://nzffdms.niwa.co.nz/, accessed 26 November 2024 and 10 September 2026).

3.1.2 Previous assessments

Previous assessments undertaken by others to accompany SAL's application for the previous Clevedon Quarry 2018 consent and PC89 (Section 1.3) were also reviewed, including:

- Historic surveys: Assessments of native lizard values across areas of the project site have been undertaken by Boffa Miskell Ltd. (BML) in 2017. The BML assessment involved the use of artificial retreats and manual habitat searches;
- An assessment of the ecological effects of changes to stream flow as a result of the quarry expansion proposed for the 2018 consent (BML, 2017a);
- An assessment of ephemeral streams potentially affected by the quarry expansion proposed for the 2018 consent (BML, 2017b); and

[7] Singers, N., Osborne, B., Lovegrove, T., Jamieson, A., Boow, J., Sawyer, J., Hill, K., Andrews, J., Hill, S., Webb, C. (2017). *Indigenous terrestrial and wetland ecosystems of Auckland.* Auckland Council.

- A terrestrial and ecological assessment based on a desktop review of available information, prepared for the PC89 application (RMA Ecology Ltd, 2021).

3.2 Specific field assessment methods

Field assessments were completed by experienced ecologists across a total of 27 site visits between 10 March 2025 and 4 August 2026, covering both terrestrial and freshwater habitats. Field observations were captured directly into ArcGIS Field Maps. No wetlands were identified during previous assessments undertaken by Boffa Miskell Ltd or RMA Ecology Ltd and no wetlands were observed in the impact or offset areas during site assessments. Wetlands are present elsewhere in the quarry landholdings; however, these will not be directly or indirectly impacted by the project and therefore wetlands are not addressed in this report.

Details of the site visits, including personnel involved and assessment type is provided in Appendix B. The locations of the terrestrial and freshwater surveys are shown in Appendix A Figure 2 and Appendix A Figure 3, respectively.

Numerous areas across the project site were inaccessible to ecologists for a variety of health and safety reasons, including the presence of excessive and unstable pine slash, large drops/steep terrain, and the presence of high numbers of wasps. Specific approaches applied to collect information in those areas is detailed in the following sections.

3.2.1 Terrestrial

3.2.1.1 Vegetation surveys and habitat assessments

Initially, a desktop review of aerial imagery was used to identify vegetation and habitats across the site. This preliminary review used aerial imagery of the whole site collected by SAL on 19 December 2024.

Vegetation and habitats present across the site were then assessed through targeted walkthrough surveys, with additional information being collected during other terrestrial site visits (Appendix B).

Quantitative vegetation assessments were undertaken using a modified Reconnaissance (RECCE) plot method (Hurst et al. 2022). Three 20 m × 20 m vegetation plots were established across the site, targeting vegetation communities assessed as being representative of the wider ecosystem type. The location of vegetation plots is provided in Appendix A Figure 2. The following information was collected at each RECCE plot location:

- Species diversity and structural tiers.
- Canopy height and cover.
- Understory height and cover.
- Basal area.

The RECCE method was not implemented across areas of structurally simple, exotic dominated and highly degraded vegetation with limited native regeneration. In these areas, assessment focussed on recording species diversity and habitat provision values for indigenous fauna.

UAV/drone photography was utilised to identify vegetation across inaccessible locations. Vegetation was mapped for this report using aerial images collected by SAL on 16 December 2025.

3.2.1.2 Avifauna

Forest bird communities were surveyed through twelve 5-minute bird counts (5MBC, Hartley & Greene 2012) undertaken between 11 and 17 March 2025. Surveys were undertaken in woody vegetation around the edge of the existing quarry and within native vegetation proposed for

removal (Appendix A Figure 2). Further surveys were undertaken in the protected native forest remnant outside of the impact area to provide information about forest bird communities in mature native forest.

In addition to formal surveys, all incidental observations of native birds were recorded.

3.2.1.3 Lizards

Potential lizard presence was assessed by suitably experienced ecologists working under the T+T National Lizard Survey Permit (107472-FAU) using the following methods:

- Manual habitat searches: Systematic manual habitat searching was undertaken across areas deemed suitable habitat for native lizards, targeting areas of rank grass/pampas, coarse woody debris, deep leaf litter, and refugia within forested areas (i.e., loose organic soils). A total of 18 person hours of manual habitat searches were undertaken across the site.
- Nocturnal spotlighting surveys: Nocturnal spotlighting was undertaken across areas of native forest to detect the presence of nocturnal arboreal geckos. A total of 12 person hours of nocturnal spotlighting was undertaken across 3 nights.

Lizard survey locations (including areas surveyed during previous assessments in 2016/2017, see Section 3.1.2) are shown in Appendix A Figure 2.

3.2.1.4 Frogs

The possible presence of native frogs was investigated through analysis of eDNA samples collected during freshwater assessments. Native Hochstetter's frog (*Leiopelma hochstetteri*) were detected in one of six replicate eDNA samples collected from Stream 1 on 11 March 2025. This resulted in tributaries of Stream 1 being surveyed for potential frog habitat by suitably experienced ecologists on 18 June 2025 and 10 June 2026.

Three further six-replicate eDNA samples were collected on 4 August 2026 to provide additional information as to whether frogs were present within tributaries of Stream 1 or restricted to the main stem. Two samples were collected from the southern tributary where potential frog habitat was identified and one on the main stem of Stream 1 upstream of the confluence with the southern tributary. These survey locations are shown on (Appendix A Figure 2)

3.2.1.5 Bats

A survey for native bats was undertaken using AR4 Acoustic Bat Monitors (ABMs) between 11 March and 2 May 2025. Ten ABMs were deployed in trees around the edge of the existing quarry and on the edge of native forest that is proposed for clearance (Appendix A Figure 2). ABMs were deployed by a suitably experienced ecologist holding DOC bat handling competencies 3.1 and 3.3. The ABMs were set to record for one hour before sunset until one hour after sunrise and batteries were changed after two weeks.

Potential bat roost trees were noted during vegetation assessments.

3.2.1.6 Terrestrial invertebrates

Potential habitat for notable endemic invertebrate species, invertebrate species with a conservation status of 'At Risk' or 'Threatened', or protected invertebrate species was identified and searched during lizard surveys at the locations shown in Appendix A Figure 2.

3.2.2 Freshwater

3.2.2.1 Stream classifications

Watercourses in the Auckland Region are classified as permanent, intermittent, ephemeral or artificial, in accordance with the definitions listed within the AUP. Intermittent and permanent streams are subject to the provisions of the AUP.

Auckland Council recommends that stream classification is undertaken between the months of July to October, when stream flows are at their peak (Neale, et *al.* 2016). Streams within the site were walked on numerous occasions between March 2025 and June 2026 (Appendix B).

Stream classifications were initially undertaken in March to coincide with favourable times for eDNA sampling; however, the ground was dry and unstable in many parts of the site preventing access to streams for classification. Therefore, most stream classifications were completed in August to October 2025, and with some additional classifications in June 2026.

At the time of the field assessments, access to some parts of the site for stream classifications was unsafe due to steep topography, unstable ground, forestry slash and/or wasps' nests. As such a hybrid approach to stream classification, which included GIS methods verified by field assessments, was applied to determine the location of intermittent/permanent streams across the four catchments (i.e. the transition points between ephemeral and intermittent streams).

Field assessment

Field assessments were carried out where stream reaches could be safely accessed. To facilitate this, the Auckland Council's Overland Flow Path Layer (OLFPL)[8] was mapped in ArcGIS Field Maps in order to indicate the likely locations of streams across the site[9].

Classification followed a two-step approach. If the stream was flowing at the time of assessment and it had been > 48 hours after a rain event likely to result in stream flow, it was considered to be a 'river or stream' and therefore was defined as either permanent, intermittent or artificial. If, at the time of assessment, the stream was not flowing, then the intermittent stream criteria were applied: a reach was classified as intermittent where three or more criteria could be assessed with confidence[10] and as ephemeral where fewer than three criteria were met. Permanent stream status was assumed, as most streams were not visited at multiple times during summer to confirm.

'Spot checks' of headwater/tributary reaches were undertaken to ground-truth the location of the actual transition points between ephemeral and intermittent streams. These ground-truthed ('GT') ephemeral to intermittent transition points were recorded in ArcGIS Field Maps.

General observations were also made of inaccessible stream channels via binoculars from afar, e.g. from gully ridges, and these were recorded and used in the GIS modelling process described below.

GIS-based classification

For stream reaches where field access was not possible, a site-specific GIS model was developed to infer ephemeral-to-intermittent transition points, using the following methodology:

- A 1 m resolution LiDAR-derived digital elevation model (DEM) (LINZ, 2024) was combined with site-specific surveyed topographic data obtained from SAL. This was then used to delineate

[8] Available from Auckland Council GeoMaps, https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html.

[9] Based on work by Storey and Wadhwa (2009), the OLFPL models flow paths based on catchment sizes and from this the extent of permanent, intermittent and ephemeral streams can be inferred.

[10] For clarity, 'assessed with confidence' refers to the reliability of the individual criteria in the context of the site. For example, if there was no upstream vegetation or source of flood debris, 'organic debris resulting from flood can be seen on the floodplain' could not be assessed with confidence.

drainage networks and associated catchments. Hydrological processing routines were applied to the DEM to derive flow direction and flow accumulation grids, including quarry removal to ensure continuous drainage flow paths. The modelled location of intermittent/permanent streams was then automatically generated based on accumulated flow thresholds.

- The GT transition points described above were spatially intersected with the delineated drainage network. The location of ephemeral/intermittent transition points recorded in previous surveys by Boffa (BML, 2017b) were also included where available. For each GT transition point, the contributing catchment area and modelled outflow volume were extracted. The resulting dataset provided a range of catchment sizes and outflow volumes characteristic of ephemeral and intermittent flow conditions.
- These derived thresholds[11] were then applied to classify modelled stream segments, allowing likely ephemeral to intermittent transition points to be inferred in inaccessible parts of the site.

The stream segments classified using the 'modelled' thresholds were then reviewed and validated in ArcGIS by an experienced freshwater ecologist, using the general observations described above where available, to determine a final classification for the streams within and surrounding the site as shown in Appendix A Figure 3.

3.2.2.2 Stream Ecological Valuations

Stream ecological valuations (SEV) (Storey et *al*., 2011; Neale et *al*., 2011; Neale et *al*., 2016) were completed by T+T on representative reaches within each of the Stream 1, Stream 2, Stream 2a, and Stream 3 catchments (Figure 1.1, Appendix A Figure 3).

The SEV provides a semi-quantitative assessment of 14 aquatic ecological functions, producing a final score between zero and one, where the higher the score, the higher the observed ecological function of the surveyed reach.

Eleven SEVs (Table 3.1) were undertaken at locations (in Appendix A Figure 3) considered representative of the range of stream characteristics across the site (both potential impact and offset sites), including stream classification (intermittent or permanent), position in catchment, landcover and topography.

SEV were undertaken predominantly in June, September and October (Table 3.1), consistent with the guidance for intermittent streams (Neale et al., 2016). Field data were entered into the Intermittent Stream SEV calculator (version 2.2, July 2012) and Permanent Stream SEV calculator (version 2.6, October 2022) for intermittent and permanent streams, respectively.

[11] Based on field observations and the GIS model, it was determined that a minimum contributing catchment size of approximately 1.4 ha gives rise to intermittent flow. This is consistent with the approximately 1 ha to 3 ha range identified by Storey & Wadhwa (2009) for the Auckland Region.

Table 3.1: SEV assessments undertaken across the site and key characteristics

Site name	SEV ID	Location description	Date assessed	Stream type (hard-bottom (HB) or soft-bottom (SB))	Classification	Total reach length assessed (m)	Macroinvertebrate protocols used
Stream 1 Tributary 1	NS_T1	Tributary	11/03/2025	HB	Intermittent	80	Unable to be sampled due to low flow
Stream 1 SEA Tributary	NS_SEA	Tributary	16/06/2025	SB	Intermittent	50	C2, P2
Stream 2 US	SS_US	Main channel upstream	03/09/2025 (SEV); 03/10/2025 (macroinvert. sample)	SB	Permanent	100	C2, P2
Stream 2 DS	SS_DS	Main channel downstream, within felled pine	13/03/2025	SB/HB mix	Permanent	100	C1, C2,[1] P2
Stream 2 DS Regenerating bush	SS_Regen	Main channel, most downstream location, within mixed exotic/native regenerating bush	10/02/2026	SB	Permanent	100	Not sampled
Stream 2a	S2	Main channel upstream within felled forestry (SEV) and downstream within mixed exotic/native regenerating bush (macroinvertebrates)[3]	03/10/2025	SB	Permanent	100	C2, P2
Stream 3 Site 5B	S5_5B[4]	Tributary	04/09/2025 (SEV); 03/10/2025 (macroinvert. sample)	SB	Intermittent	70	C2, P2
Stream 3 Overburden (OB)	S5_OB[4]	Tributary	15/10/2025 (SEV); 03/11/2025	SB/HB mix	Intermittent	70	C2[2], P2

Site name	SEV ID	Location description	Date assessed	Stream type (hard-bottom (HB) or soft-bottom (SB))	Classification	Total reach length assessed (m)	Macroinvertebrate protocols used
			(macroinvert. sample)				
Stream 3 East	S5_ET	Tributary	16/10/2025	SB/HB mix	Intermittent	50	Not sampled – proposed offset/compensation site
Stream 3 West	S5_WT	Tributary	15/10/2025	SB/HB mix	Intermittent	50	Not sampled – proposed offset/compensation site
Stream 3 Main channel	S5_DS_4	Main channel, lower catchment	15/10/2025	HB	Permanent	100	Not sampled – proposed offset/compensation site

[1] Both -sb and non-sb MCI metrics are reported.

[2] Although sediments were mixed, sampling protocols followed the method for the predominant substrate (soft) at this site.

[3] Macroinvertebrate sampling was conducted in this location as water levels were insufficient further upstream at the SEV site.

[4] Also used as representative offset site SEV in SEV/ECR calculations.

3.2.2.3 Aquatic macroinvertebrates

Aquatic macroinvertebrate community structure, abundance and diversity are standard indicators of the long-term health of streams. Different taxa show varying tolerance of pollutants, so their presence or absence gives an indication of stream condition.

Where flow was sufficient, a macroinvertebrate community sample was taken within each SEV reach within the life of quarry or OBDA footprint (Table 3.1). Sampling was undertaken in accordance with Stark et *al.* (2001) protocols C1 (for hard bottomed streams) and C2 (for soft-bottomed streams)[12]. Samples were preserved in 70 % ethanol and sent to Geotechnics Tauranga for taxonomic processing and identification. A 200 fixed count plus scan for rare taxa was undertaken for each sample (Protocol 2 in Stark et *al*., 2001). Specimens were identified to species level where possible. Table 3.1 below shows a breakdown of all macroinvertebrate sampling sites, including date sampled, bottom structure, and sampling protocols used, while the locations of sampling are indicated on the map in Appendix A Figure 2.

Freshwater macroinvertebrate results were analysed using the indices within Stark and Maxted (2007) which are summarised as follows:

- **Macroinvertebrate Community Index (MCI)sb and Quantitative MCI-sb** are indices which reflect the sensitivity of the macroinvertebrate community to changes in water quality and habitat, where higher scores indicate better stream condition. Macroinvertebrate index values are then translated to quality classes which describe the ecological health of the stream (refer to Table 3.2 for interpretation of these indices).
  - **MCI-sb** is an index for assessing the quality class of a stream using presence or absence of macroinvertebrates.
  - **QMCI-sb** is similar to MCI-sb but includes a weighting for taxa abundance within the community.
- Ephemeroptera, Plecoptera and Trichoptera (**EPT**) taxa are insect groups generally dominated by pollution-sensitive species. An increased abundance of EPT taxa generally indicates improved long-term water quality.

Table 3.2: Interpretation of MCI-type indices (per Stark & Maxted, 2007a)

Quality class (Stark & Maxted, 2007a)	MCI / MCI-sb	QMCI / QMCI-sb
Excellent	> 119	> 5.99
Good	100 - 119	5.00 – 5.99
Fair	80 – 99	4.00 – 4.99
Poor	< 80	< 4.00

Note: Both MCI and QMCI values are synonymous with their soft-bottomed variants (i.e., MCI-sb and QMCI-sb).

[12] A hard bottomed stream is defined by > 50 % hard substrate types (gravels, cobbles, boulders etc); a soft bottomed stream is dominated by > 50 % fine sediments < 2 mm in size.

3.2.2.4 Fish

Fish community composition in each of the streams was assessed using a combination of desktop review and environmental DNA (eDNA[13]) sampling. As there was existing fish survey information from the 2018 consent (BML, 2017a) for most of the affected catchments, eDNA sampling was considered sufficient to supplement existing information to inform the values assessment.

eDNA surveys were undertaken at eight locations across the site (Table 3.3; Appendix A Figure 3). Each sample involved the collection of six replicates using Wilderlab standard eDNA mini kits (1.2 µm filter) from the sampling site, in accordance with Wilderlab methods (Wilderlab, 2024). Samples were sent to Wilderlab for basic multispecies analysis.

eDNA results were interpreted using Wilderlab (2022). Melchior and Baker (2023) provide additional guidance on interpreting eDNA sequence counts. Based on current data and the high sensitivity of eDNA testing, the guidelines propose that sequence counts falling below a threshold of 100 in at least 2 out of the 6 replicates be flagged as 'trace detection'. Consistent with this, results considered 'trace detection' based on this definition have been noted in the eDNA results tables presented in Section 4.2.

Table 3.3: eDNA sampling locations and dates

Location	Location (NZTM)	Date(s) sampled
Stream 1 main channel – downstream	1784729E, 5900024N	11/03/2025
Stream 1 main channel – upstream	1785527E, 5900200N	04/08/2026
Stream 1 main southern tributary – downstream	1785518E, 5900173N	04/08/2026
Stream 1 main southern tributary – upstream	1785902E, 5899961N	04/08/2026
Stream 2 main channel	1784767E, 5899611N	13/03/2025, 05/11/2025
Stream 2a main channel	1784687E, 5899433N	03/10/2025
Stream 3 main channel - lower	1784438E, 5898975N	13/03/2025
Stream 3 main channel – upstream of 'lower' sample	178900E, 5898877E	03/11/2025

3.3 Approach to ecological impact assessment

3.3.1 Values and effects

The method applied to this EcIA broadly follows the Ecological Impact Assessment Guidelines 2018 (EcIAG) published by the Environmental Institute of Australia and New Zealand (EIANZ) (Roper-Lindsay et al., 2018). The guidelines include a standardised framework and matrix that we have applied in our assessment of ecological effects.

The guidelines were used to establish the following (refer to Appendix C for the criteria and Tables used in this assessment):

- The terrestrial and freshwater ecological values within the site (Appendix C Table 1 to Appendix C Table 4).

[13] eDNA is the genetic material that is obtained from environmental samples, in this case, water. This method allows for a rapid assessment of the biodiversity present within a catchment of a site and records a high percentage of animal (including fish) trace DNA present within the environmental sample. This method provides information on presence/absence information only, as the number of positive eDNA reads (identification) is not directly correlated to species density.

- The magnitude of effect (Appendix C Table 5) on ecological values from the project in the absence of any effects measures.
- The overall level of effects to determine whether avoidance, minimisation or remediation is recommended (Appendix C Table 7).
- The magnitude of effect and overall level of effect, taking into consideration any additional measures to avoid, minimise[14] or remedy effects.
- Where an overall level of effect is moderate or higher, after applying proposed measures to avoid, minimise and remediate effects, then additional effects management in the form of offset and/or compensation is recommended to achieve a no net loss of biodiversity values. Section 3.3.2 details the approach to addressing residual effects.

The EcIAG states that practitioners may deviate from the guidelines framework where it is considered ecologically relevant and justifiable to do so.

While the assessment criteria for terrestrial values are well defined in the EcIAG (Appendix C Table 1 to Appendix C Table 3), the freshwater values are less so. For this assessment, we have adapted freshwater values criteria based on the EcIAG (Appendix C Table 4) which assigns ecological value based on biodiversity and ecological function values of the freshwater stream systems. The criteria within Appendix C Table 1 has also been applied to assess freshwater fauna values based on the national and regional conservation status of the fish and large macroinvertebrate species present. For the purposes of this assessment, the regional threat classification status of freshwater fish species (as per Bloxham et al., 2023) was considered to correspond to the equivalent national threat classification in the values assessment. i.e. a species with a regional threat classification status of 'Threatened – Endangered, Critical or Vulnerable' was considered to have 'very high' ecological value.

Note that the NPS-FM and AUP require consideration of the loss of 'potential' value of freshwater systems is incorporated into assessments of effects. As such, the ecosystem function value of freshwater systems is provided as a 'current' value and a 'potential' value. Where different to 'current', an ecological impact assessment has also been completed on the potential value of freshwater systems within this EcIA. This qualitative assessment considered the likely future land use in the catchment and any associated constraints on or opportunities for improvement of the current ecological values.[15] In addition, a quantitative assessment of potential value of streams (i.e. modelled potential SEV values for impact streams) was also considered within the recommended offset actions where residual adverse effects were identified. The assumptions applied in these assessments are detailed further in the relevant sections below.

3.3.2 Residual effects

It is generally accepted that if after all efforts to avoid, minimise, remedy and mitigate effects, there remains an overall effect of moderate or higher magnitude, then further efforts are recommended to address these 'residual adverse effects' by way of offset or compensation.

3.3.2.1 Biodiversity offset

A Biodiversity offset is a 'measurable conservation outcome' that meets certain principles and balances adverse residual effects that cannot be reasonably avoided, minimised, remedied and/or

[14] Note: Minimise is one of the steps in the effects management hierarchy as defined in the NPS FM and IB. Within this EcIA the word minimize is equivalent to mitigate under the RMA.

[15] The majority of the proposed life of quarry extent is located within the SPQZ, which anticipates the use of this area for quarrying activities. Notwithstanding this, for the purposes of this ecological assessment, the potential ecosystem function value was assessed based on the likely land use that may occur in the absence of the proposed quarrying activity.

mitigated to a no net loss/net gain standard (Baber et al., 2021a, b, c). Biodiversity offsetting uses quantifiable information to address residual adverse effects.

A Biodiversity Offsets Accounting Model (BOAM, Maseyk et al., 2015) approach was used to determine the quantum of offset recommended to address residual ecological effects associated with the loss of terrestrial fauna habitat. The approach aims to counterbalance the unavoidable impacts of development activities on biodiversity by enhancing the state of biodiversity elsewhere. In this case, the loss of fauna habitat is offset through restoration planting in a nearby catchment, with a full description provided in Section 7. Refer to Maseyk et al. (2015) for a full description of the BOAM methodology.

3.3.2.2 Environmental Compensation Ratio

The Environmental Compensation Ratio (ECR) is a standardised tool used to quantify the amount of streambed area that is required to be created or restored relative to the amount lost to maintain a 'no net loss' in ecological function as a result of the project.

The SEV and ECR is a robust and internationally peer reviewed method (Neale, et al. 2011), designed to quantify the ecological function of a stream reach and, where all measures to avoid, remedy and mitigate effects have been exhausted, it provides a means to quantify offset requirements. The method has been applied in New Zealand to support resource consent applications, including applications that have been heard at Council Hearings, Boards of Inquiry and at the Environment Court[16].

The ECR calculation formula (provided in Storey et al, 2011 and Appendix D_ECR multiplier and staging assumptions) was used in this assessment to determine the quantum of offset to address residual adverse freshwater effects, with an adjustment to the multiplier as explained below.

While not explicitly defined in the SEV guidance (e.g. Storey et al, 2011; Neale et al., 2016), the 1.5 multiplier used in the ECR formula is commonly considered to account for time lags before the full benefits of offset (i.e. stream restoration) measures are realised, and/or differences between expected and actual offset outcomes. For the purposes of this assessment, the multiplier was adjusted to reflect timing of the implementation of offset measures relative to the timing of impacts, on the basis that time lags and risks of unmet offset outcomes would be reduced. The multiplier assumptions applied are discussed further along with the ECR calculations presented in Section 6.

[16] Examples include NZTA Te Ahu a Turanga: Manawato Tararua Highway project and Mt Messenger Bypass Project.

4 Ecological characteristics and values

4.1 Terrestrial

4.1.1 Vegetation and habitat types

Four vegetation types have been identified and mapped within the impact area, following the methodology outlined in Section 3. The vegetation types present within the impact area are:

- Regenerating tree fern/broadleaf forest (6.1 ha).
- Cutover pine (55.4 ha).
- Tree privet-kānuka treeland (0.5 ha).
- Exotic shrubland (2.0 ha).

The remainder of the 74 ha LOQ comprises the existing quarry and associated infrastructure.

Two native vegetation remnants are present within the Stream 3 catchment, outside of the impact area:

- Mixed broadleaf forest (4.9 ha, referred to as the protected forest remnant).
- Mixed broadleaf treeland (3.4 ha).

The extent of each vegetation type is shown in Appendix A Figure 4.

4.1.1.1 Regenerating tree fern/broadleaf forest

Regenerating tree fern–broadleaf forest occurs within the northern extent of the site, including within the impact area. This vegetation is within SEA_T_5588, which encompasses most native vegetation within the Hunua Ranges and numerous remnant fragments of native vegetation on the fringe of the Hunua Ranges. Aerial images from the 1940s show this area as grazed pasture then the area began transitioning to scrub in the 1950s. Images from the 1960s suggest some of the area may have been returned to pasture, then images from the 1970s onwards show the whole area as scrub.

This vegetation type comprises a mosaic of areas with canopy cover dominated by tree fern (Photograph 4.1) or mixed-broadleaf species (Photograph 4.2). Within the tree fern dominant areas, the canopy is largely ponga (*Alsophila dealbata*). Within the broadleaf dominant areas, the canopy consists of māhoe (*Melicytus ramiflorus*), patē/seven-finger (*Schefflera digitata*), and ponga. Mānuka and kānuka are locally common in the canopy. The sub-canopy throughout this vegetation comprises wheki (*Dicksonia squarrosa*), kawakawa (*Macropiper excelsum*), hangehange (*Geniostoma ligustrifolium*) and nīkau (*Rhopalostylis sapida*). The understory supports a diverse assemblage of ground ferns and native grasses, including shining spleenwort (*Asplenium oblongifolium*), sickle spleenwort (*Asplenium polyodon*), and meadow rice grass (*Microlaena stipoides*). A total of 26 plant species were observed in this vegetation type within this area.



Photograph 4.1: Regenerating tree fern/broadleaf forest. Photograph showing an area dominated by tree fern species with interspersed māhoe. Photograph taken 5 November 2025.



Photograph 4.2: Regenerating tree fern/broadleaf forest. Photograph showing an area dominated by broadleaf species. Photograph taken 4 November 2025.

This vegetation type aligns with the ecosystem classification of 'VS5 – Broadleaved species scrub/forest' (Singers et al 2017). VS5 communities are characterised by diverse assemblages of broadleaved species, with compositional variability strongly influenced by factors such as humidity, gully position, elevation, exposure, and other topographic and climatic gradients.

The vegetation provides potential nesting and foraging habitat for common forest birds. Long-tailed bats may forage over the vegetation, but it is unlikely that the forest provides any roosting habitat due to the age of the trees (approximately 30 years old) and species composition. Suitable habitat for ground dwelling lizards is present throughout the area in the form of dense leaf litter and coarse woody debris, with habitat for arboreal lizards less prevalent throughout the forest primarily in the form of knots and holes on māhoe or flaking bark on mānuka (*Leptospermum scoparium*) and kānuka.

Based on the above considerations, this vegetation type has been assigned an ecological value of **high**.

4.1.1.2 Cutover pine

The cutover pine vegetation community has established amongst felled pine slash and bare earth and consists predominantly of exotic herbaceous and shrub vegetation with scattered native species present in low abundance (Photograph 4.3).

Common exotic species within this vegetation community include gorse (*Ulex europaeus*), black nightshade (*Solanum nigrum*), fireweed (*Chamaenerion angustifolium*), Scotch thistle (*Cirsium vulgare*), horseweed (*Erigeron canadensis*), pampas grass (*Cortaderia selloana*), and woolly nightshade (*Solanum mauritianum*). Woolly nightshade is listed by the Ministry for Primary Industries (MPI) as an unwanted organism as defined by the Biosecurity Act 1993. The established weed species are well adapted to rapid colonisation of disturbed soils and frequently dominate cutover pine sites. Native species including māhoe and pate are scattered throughout, generally occurring in higher densities within gulleys and riparian margins and in small numbers on slopes.



Photograph 4.3:Representative image of cutover pine vegetation. Photograph taken 18 December 2025.

The cutover pine area is subject to frequent and irregular disturbance associated with forestry operations, including mechanical site preparation, herbicide application, and manual weed control undertaken to facilitate pine replanting. These activities suppress successional development and favour disturbance-tolerant exotic species, resulting in a patchy and highly transient vegetation type and structure. Across the cutover pine area, spatial variation in vegetation density and composition results from differences in topography and the intensity of forestry operations. Higher vegetation cover typically occurs where disturbance was limited and closer to watercourses.

This vegetation type is dominated by exotic species and is therefore not representative of a naturally occurring ecosystem. It also provides low value habitat for native fauna and is subject to high levels of disturbance. As such, it has been assigned an ecological value of **negligible**.

4.1.1.3 Tree privet-kānuka treeland

Approximately 0.5 ha of tree privet-kānuka treeland is present on a steep slope to the east of the existing quarry (Appendix A Figure 4). The treeland comprises an open canopy of 80% tree privet and 20% kānuka over kikuyu grass (*Cenchrus clandestinus*) with occasional pampas grass or gorse. This vegetation was described and mapped in 2017 for the 2018 consent, which authorised its removal, and it has not changed materially in composition or ecological value since it was previously assessed.

The treeland provides foraging and potential nesting habitat for native bird species. Scattered kānuka provides potential habitat for native geckos; however, the sparse canopy and lack of connectivity to other habitat means geckos are unlikely to be present. Similarly, high levels of disturbance and lack of connectivity mean it is unlikely that native skinks are present. It is unlikely that the trees provide roosting habitat for long-tailed bats.

Despite being dominated by pest plants, the treeland provides potential nesting habitat for native birds and is considered to have an ecological value of **low**.

4.1.1.4 Exotic shrubland

Around 2.0 ha of exotic shrubland vegetation is present on the eastern side of the existing quarry footprint (Appendix A Figure 4). This vegetation comprises exotic shrubs including gorse, blackberry, and woolly nightshade growing over kikuyu grass. Inkweed and pampas are also common in this area.

This vegetation may provide habitat for native skinks; however, high levels of disturbance and a lack of connectivity to better habitat mean it is unlikely that skinks are present. It does not provide roosting habitat for long-tailed bats. Larger shrubs and open grass areas may provide nesting habitat for native birds.

Despite being dominated by pest plants, the exotic shrubland provides potential nesting habitat for native birds and is considered to have an ecological value of **low**.

4.1.1.5 Mixed broadleaf forest (protected forest remnant)

The protected forest remnant at the top of the Stream 3 catchment comprises mixed broadleaf forest (Appendix A Figure 4). The forest contains a diverse mix of native species with very few pest plants present. Of interest is a population of king fern, a native species with a national and regional conservation status of 'At Risk-Declining'.

The dense canopy includes tawa (*Beilschmiedia tawa)*, hīnau (*Elaeocarpus dentatus*), karaka (*Corynocarpus laevigatus*), and kohekohe (*Didymocheton spectabilis*) up to approximately 12 m in height with a subcanopy of māhoe, nīkau, and pigeonwood (*Hedycarya arborea*). Due to the dense canopy, the groundcover is largely leaf litter, with scattered kawakawa (*Piper excelsum*), kohekohe, mahoe, and ground ferns common across the forest floor. A representative aerial photograph of this forest is shown in Photograph 4.4 below.

This forest provides high-quality habitat for a broad range of native bird species. Multiple trees containing potential bat roost features were observed and it is likely that bats use this area for foraging and roosting. The forest provides potential habitat for native skinks and geckos.

This area of forest is considered to have **very high** ecological value.



Photograph 4.4: representative aerial photograph of mature broadleaf forest. Photograph taken on 18 December 2025.

4.1.1.6 Mixed broadleaf treeland

An area of mixed broadleaf treeland is present within the Stream 3 catchment on very steep terrain either side of a waterfall (Appendix A Figure 4). The treeland comprises a diverse range of mature native trees including kohekohe, taraire, and rewarewa (*Knightia excelsa*). The subcanopy is largely tree privet, with māhoe, nīkau, mamaku (*Sphaeropteris medullaris*), and gully tree fern (*Alsophila cunninghamii*) also present. Steep slopes are vegetated with grass, ferns, tutu (*Coriaria arborea*) and occasional kiekie (*Freycinetia banksia*), with bare earth and rock bluffs. A representative aerial photograph is shown in Photograph 4.5 below.

The treeland provides good quality nesting and foraging habitat for native birds. Large trees may provide roosting habitat for long-tailed bats and potential habitat for native skinks and geckos is present. This vegetation has an ecological value of **high**.



Photograph 4.5: Representative photograph of Mixed broadleaf treeland. Photograph taken 18 December 2025.

4.1.2 Flora

The NZPCND has three plant species lists from locations close to the site:

- Wairoa Gorge (compiled in 1979, 172 plant records).
- Wairoa Falls (compiled in 2006, 133 plant records).
- Hunua Falls (compiled in 1976, 171 plant records).

Of the species recorded in the above lists, 10 have a national conservation status of 'At Risk' and three have a national conservation status of 'Threatened' as per de Lange et al. (2024). None of the nationally 'At Risk' or 'Threatened' recorded in NZPCND species lists were observed at the site.

In total, 48 indigenous and 10 exotic plant species were observed at the site (a full list of plant species observed at the site is provided in Appendix E). All species have a national and regional conservation status of 'Not Threatened' with the exception of king fern (*Ptisana salicina*), which has a national and regional conservation status of 'At Risk – Declining' (de Lange et al 2024, Simpkins et al., 2025). King fern was observed within the regenerating tree fern/broadleaf forest and within the protected native forest remnant, particularly at the base of stream gullies. No other nationally or regionally 'At Risk' or 'Threatened' species were recorded in the impact areas.

Based on the regional and national threat status of 'At Risk – Declining', king fern has been assigned an ecological value of **high**.

4.1.3 Fauna

4.1.3.1 Avifauna

A review of iNaturalist and eBird[17] databases found records of 13 native bird species that may use habitats at the site for nesting (Table 4.1). The native forest bird community recorded during 5MBCs and incidentally during site assessments comprised common 'Not Threatened' species (Table 4.1). No nationally or regionally 'At Risk' or 'Threatened' native bird species were observed. No 'At Risk' or 'Threatened' birds are considered likely to nest within the impact area.

Table 4.1: Bird species recorded at the site and species recorded during database searches that may use habitats at the site.

Common name	Māori name	Scientific name	National conservation status (Robertson *et al.*, 2021)	Regional conservation status (Woolly et al., 2024)	Desktop records	Recorded during site assessments
Kaka	Kākā	*Nestor meridionalis*	At Risk - Recovering	Regionally Recovering	eBird, iNat	N
Bellbird	Korimako	*Anthornis melanura*	Not Threatened	Regionally Recovering	eBird, iNat	N
Swamp Harrier	Kāhu	*Circus approximans*	Not Threatened	Regionally Not Threatened	iNat	N
Kereru	Kererū	*Hemiphaga novaeseelandiae*	Not Threatened	Regionally Not Threatened	eBird, iNat	Y
Tomtit	Miromiro	*Petroica macrocephala*	Not Threatened	Regionally Not Threatened	eBird, iNat	N
Shining cuckoo	Pīpīwharauroa	*Chrysococcyx lucidus*	Not Threatened	Regionally Not Threatened	eBird, iNat	N
Fantail	Pīwakawaka	*Rhipidura fuliginosa*	Not Threatened	Regionally Not Threatened	eBird, iNat	Y
Grey warbler	Riroriro	*Gerygone igata*	Not Threatened	Regionally Not Threatened	eBird, iNat	Y
Morepork	Ruru	*Ninox novaeseelandiae*	Not Threatened	Regionally Not Threatened	eBird	N
Silvereye	Tauhou	*Zosterops lateralis*	Not Threatened	Regionally Not Threatened	eBird, iNat	Y
Tūī	Tūī	*Prosthemadera novaeseelandiae*	Not Threatened	Regionally Not Threatened	eBird, iNat	Y
Spur-winged plover		*Vanellus miles*	Not Threatened	Regionally Not Threatened	eBird, iNat	N
Welcome Swallow	Warou	*Hirundo neoxena*	Not Threatened	Regionally Not Threatened	eBird, iNat	N

Note: no nesting habitat for kākā is currently present within the impact area; however, suitable cavities may develop in the regenerating tree fern/broadleaf forest once it matures.

4.1.3.2 Lizards

A review of the DOC Herpetofauna Database and Auckland Council Herpetofauna Atlas identified five native lizard species within a 10 km radius of the site (Table 4.2). All five of these lizards are

[17] "Hunua-Massey Cossey loop track" and "Hunua Falls loop" hotspots.

classified as Regionally 'At Risk' (Melzer et al., 2022a). An assessment of the likelihood of presence based on distribution and/or habitat requirements has been provided in Table 4.2.

Table 4.2: Lizard species recorded within a 10 km radius of the project site (DOC; DOC Herpetofauna Atlas, AC: Auckland Council Herpetofauna atlas)

Common name	Species name	National conservation status	Regional conservation status	Presence	Data source
Auckland green gecko/elegant gecko	*Naultinus elegans*	At Risk – Declining	At Risk – Regionally Declining	Possible	DOC, AC
Striped skink	*Oligosoma striatum*	At Risk – Declining	At Risk – Regionally Declining	Unlikely	AC
Forest gecko	*Mokopirirakau granulatus*	At Risk – Declining	At Risk – Regionally Declining	Possible	DOC
Pacific gecko	*Dactylocnemis pacificus*	Not Threatened	At Risk – Regionally Declining	Possible	DOC
Copper skink	*Oligosoma aeneum*	At Risk – Declining	At Risk – Regionally Declining	Likely	DOC

Within the impact area, regenerating tree fern/broadleaf forest vegetation provides good potential habitat for native skinks and geckos and rank vegetation on forest edges provide good potential habitat for native skinks. No native lizards were detected during manual searching or spotlighting (locations shown in Appendix A Figure 2) and, no confirmed native lizards were detected in previous surveys undertaken across the site in 2016/2017. Two unidentified skinks were observed in 2016/2017 on the edge of pine forest that has since been felled (BML 2017). While these may have been native, given the habitat they were observed in it is more likely that they were exotic plague skinks (*Lampropholis delicata*). This species was observed throughout the site during recent surveys, and it is an Unwanted Organism under the Biosecurity Act 1993.

The site has been subject to high levels of disturbance since at least the 1940s when historic aerial images sourced from Auckland Council GeoMaps show the whole site was pasture with no connectivity to remnant native vegetation in the Hunua Ranges. This, together with no native lizard detections during extensive survey work over a number of years, means it is unlikely that any native lizards are present. As a result, lizards are not considered further in this report.

4.1.3.3 Frogs

DOC and Auckland Council herpetofauna database hold numerous records of Hochstetter's frog from the Hunua Ranges. Hochstetter's frog has a national conservation status of 'At Risk-Declining' (Burns et al 2025) and a regional conservation status of 'At Risk' (Meltzer et al 2022b).

Hochstetter's frogs were detected in one of six replicate eDNA samples collected from Stream 1 (Appendix A Figure 5) in March 2025, which counts as a "trace detection" and may not be indicative of Hochstetter's frogs being present (see Section 3.2.1.4). During the follow up survey in August 2026, Hochstetter's frogs were again detected in one of six replicate eDNA samples collected from the main stem of Stream 1, upstream of the confluence with the southern tributary (Appendix A Figure 5). Hochstetter's frogs were not detected in two six-replicate samples collected from the southern tributary.

Field assessments confirmed that some reaches of Stream 1 and the southern tributary provide potential habitat for this species (Appendix A Figure 5). No frogs were observed during opportunistic searches of suitable habitat in the southern tributary undertaken during habitat mapping.

Potential frog habitat associated with the main stem of Stream 1 was most prevalent on small side tributaries higher up in the catchment, where low flows and hard bottomed substrates were present. Limited areas of rock cascades provided the most effective frog habitat; however, habitat quality was limited by excess silt and sediment throughout the catchment.

The Stream 1 southern tributary provided marginal to moderate quality frog habitat where areas of large cobbles and rock cascades occurred, but again habitat quality was reduced by excess sediment as well as higher flows.

All potential frog habitat is outside of the direct impact area.

Due to their conservation status, Hochstetter's frog is considered to have **high** ecological value.

4.1.3.4 Bats

The Hunua Ranges and surrounding areas are a known stronghold for long-tailed bats with large numbers of records of this species within 10 km of the site. Long-tailed bats were detected during previous surveys at the site, including most recently in 2024.

As expected, long-tailed bats were detected on all 10 ABMs deployed for this assessment (Table 4.3). No bat activity was indicative of roosting. Feeding buzzes (distinctive spectrograms produced immediately prior to a bat catching a prey item) were recorded on six of the ten ABMs. Bats are likely to use the site for foraging and to commute between the Wairoa River and the Hunua Ranges.

Mean activity levels were generally low (>10 passes per night on seven of the ten ABMs), which is likely due to disturbance caused by recent pine harvesting. The highest activity levels were recorded on the eastern edge of the site closest to the Hunua Ranges on the edge of the protected native forest remnant (Appendix A Figure 6). The lowest activity rates were recorded at ABM82 on the edge of the existing quarry footprint (0.5 passes per night) and two ABMs on the edge of the regenerating tree fern/broadleaf forest where active pine felling was being undertaken during the ABM survey.

One remnant pine tree on the edge of the regenerating tree fern broadleaf forest contains low-quality potential roost features in the form of flaking bark and small cracks and crevices (Appendix A Figure 6). The ABM placed in this tree (ABM85, Table 4.3) recorded an average of 0.1 passes per night, the lowest activity recorded at any of the ABMs. Other than this single tree, no roosting habitat is currently present within the impact area. Several trees providing high-quality potential roosting habitat were observed in the protected native forest remnant and it is likely that there are also potential roost features in the mature native treeland.

Due to their conservation status, long-tailed bats have been assigned an ecological value of **very high**.

Table 4.3: ABM survey results. ABMs were deployed on 11 March 2025 and collected on 2 May 2025.

ABM #	ABM GPS coordinates	ABM GPS coordinates	Number of nights recording	Number of passes	Mean number of passes per night	Number of spectrograms with feeding buzzes
AKL79	1786276.53	5899639.23	23	152	**6.6**	7
AKL80	1784729.85	5899677.14	16	52	**3.3**	0
AKL82	1784809.47	5899979.07	53	24	**0.5**	1
AKL83	1785166.31	5899932.42	52	617	**11.9**	6
AKL84	1784645.47	5899966.48	22.5	29	**1.3**	0
AKL85	1785924.7	5899725.5	29.5	2	**0.1**	0
AKL86	1786311.92	5899209.77	33.5	866	**25.9**	26
AKL87	1784970.76	5899948.69	51.5	183	**3.6**	6
AKL88	1785611.36	5899726.99	36.5	8	**0.2**	0
AKL89	1786276.46	5899434.08	27	688	**25.5**	29

4.1.3.5 Terrestrial invertebrates

Based on a desktop assessment, it was considered unlikely that any invertebrate species with protection under the Wildlife Act 1953 are present within the impact area. Similarly, it was considered unlikely that any invertebrate species with a conservation status of 'At Risk' or 'Threatened', or notable endemic species such as *Rhytida greenwoodii* and peripatus (*Peripatoides* spp.) are present.

No protected, 'At Risk' or 'Threatened', or notable endemic terrestrial invertebrate species were detected during manual hand searching. Therefore, terrestrial invertebrates are not considered further in this report.

4.1.3.6 Pest mammals

Possums (*Trichosurus vulpecula*) were observed during spotlighting and rabbit (*Oryctolagus cuniculus*) sign was observed. Rats (*Rattus* spp.), mice (*Mus musculus*), and mustelids (*Mustela* spp.) are almost certainly present. No sign of feral ungulates was noted.

4.2 Freshwater

4.2.1 Habitat

This section describes the freshwater habitats, including SEV values, across the four catchments within and surrounding the site. Streams within these catchments comprise small intermittent headwater systems through to second order streams, all of which drain to the Wairoa River (Appendix A Figure 3). The SEV values referred to in the subsections below are included in Appendix F along with the SEV function scores for each site. Cross-section photographs are provided in Appendix G.

For context, the approximate total length of intermittent and permanent stream within these four catchments[18], are:

- Stream 1: 6,180 m;
- Stream 2: 1,700 m;
- Stream 2a: 520 m; and
- Stream 3: 6,000 m.

4.2.1.1 Stream 1

4.2.1.1.1 Main channel

The Stream 1 main channel is a permanent, hard-bottomed first-order stream with high hydrological heterogeneity, including runs, riffles, chutes, small waterfalls and pools. Substrates range from bedrock and boulders to cobble, gravel and silt/sand. The upper catchment and true right bank feature predominantly native regenerating vegetation within an SEA designation. The main channel is generally well shaded (Photograph 4.6) and supports diverse fish habitat, with kōura also present. The true left bank of the lower reaches is bordered by consented quarry and/or exotic forestry. The previous SEV score of 0.73 recorded by BML (2017a) for the lower reaches indicates high ecological value, and it is likely that this reflects current SEV values within this part of the catchment. Values are likely to be higher in the less-modified upper reaches.

A concrete culvert (Ø 1200 mm) is situated on the main channel just upstream of the confluence with the Wairoa River. The culvert did not appear to be perched and the diverse fish community upstream suggests it is not acting as a significant barrier to fish passage.



Photograph 4.6: Representative photograph, Stream 1 main channel. Photograph taken 13 March 2025.

[18] As mapped via the methodology in Section 3.2.2.1. For parts of the Stream 1 catchment that were not classified by this method (tributaries of the main northern tributary and tributaries on the northern side of the main channel) the length of >1 ha catchment OLFP channels – a total of approximately 2,020 m – were measured.

4.2.1.1.2 Tributaries

The upper Stream 1 catchment is divided into two main tributaries, referred to here as the main northern tributary and the main southern tributary (Appendix A Figure 3), both within native regenerating vegetation. The main southern tributary featured high shading with hard substrates including large cobbles and rock cascades, although high fine sediment loading was also noted.

The smaller Stream 1 tributaries feeding the main tributaries and the main channel directly are predominantly intermittent headwater streams within regenerating native vegetation (Photograph 4.7). Some reaches were affected by recent pine harvesting, as indicated by high fine-sediment loads. They were generally well shaded, with high organic-matter inputs, limited macrophyte and periphyton growth, and moderate habitat diversity provided by woody debris, undercut banks, root mats, cobble and pools. The representative tributaries surveyed, 'Stream 1 Tributary 1' and 'Stream 1 SEA Tributary' had SEV scores of 0.74 and 0.71 (Appendix F), respectively, which are considered typical scores of high-value streams (Appendix C Table 4).



Photograph 4.7: Representative photograph, Stream 1 Tributary 1 SEV reach. Photograph taken 13 March 2025.

4.2.1.2 Stream 2

The Stream 2 main channel shows a clear upstream–downstream gradient. The upper reach and associated tributaries are intermittent, soft-bottomed and situated within recently felled pine forestry (Photograph 4.8). These reaches had low shading, high fine-sediment and woody-debris loads, sparse exotic-dominated riparian vegetation and reduced habitat heterogeneity. The upper reach SEV score was 0.44, a typical score for a stream of moderate freshwater ecological values (Appendix C Table 4).

The lower channel is generally permanent and contained a more diverse range of substrates and hydraulic features, such as riffles, runs, chutes, pools, and waterfalls. However, the reach within felled forestry remained affected by high sediment loads and forestry slash coverage, very low shading and excessive macrophyte growth in more open sections, and had an SEV score of 0.54. In

contrast, the lower reach within regenerating mixed exotic/native vegetation was well shaded and characterised by permanent flow, with high hydrological heterogeneity, including incised bedrock banks and abundant habitat features. This reach SEV score was 0.77, indicating high ecological value and providing a strong contrast with the upstream forestry-affected reaches.



Photograph 4.8: Overview photograph of Stream 2 catchment, looking across recently felled pine forestry towards the mixed exotic/native regenerating area. Photograph taken 3 September 2026.

4.2.1.3 Stream 2a

Similar to Stream 2, Stream 2a has a pronounced downstream–upstream contrast. The lower reach within regenerating exotic/native bush is hard-bottomed and characterised by a long sequence of cascades and waterfalls, with high shading and native riparian cover. It is expected to have habitat and SEV values similar to the Stream 2 regenerating-bush reach.

Approximately 200 m upstream, the stream passes into recently felled pine forestry (Photograph 4.9) and becomes intermittent and soft-bottomed. This section was affected by high fine-sediment and slash loads, sparse riparian vegetation and reduced hydrological heterogeneity. The SEV score of 0.37 reflects low freshwater ecological value. A perched culvert (Ø 300 mm) near the stream's confluence with the Wairoa River is also likely a significant constraint on fish passage.



Photograph 4.9: Representative photograph of Stream 2a SEV reach, looking downstream towards the exotic/native regenerating vegetation in the lower reaches. Photograph taken 3 October 2025.

4.2.1.4 Stream 3

4.2.1.4.1 Main channel

The Stream 3 main channel is a permanent second-order, hard-bottomed stream with relatively high hydrological heterogeneity, including runs, riffles, pools, chutes and small waterfalls. It has a diverse substrate assemblage of bedrock, boulders, cobble, gravel and silt/sand, and is considerably larger than the other assessed channels (Photograph 4.10). The sampled reach was within recently felled pine forestry and had very low shading, sparse weedy riparian vegetation and abundant forestry slash, although the slash did not generally smother the channel due to its large wetted width (average of 2.84 m along the SEV reach). The SEV score of 0.60 indicates moderate to high ecological value. Habitat values are likely to be higher through the remnant native bush in the middle of the catchment.

Upstream of the SEV reach, the stream transitions into a series of cascades and waterfalls heading up into a remnant native bush block for approximately 250 m, before emerging again into the felled forestry area. Here the riparian margins featured mixed native and exotic tree and shrub species that were beginning to regenerate.



Photograph 4.10: Stream 3 Main Channel SEV reach (downstream extent), looking upstream. Photograph taken 15 October 2025.

4.2.1.4.2 Tributaries

The Stream 3 tributaries are generally intermittent and occur within recently felled pine forestry. The SEV Sites '5B' and the 'Overburden Tributary' are soft-bottomed, steep-sided reaches with high woody-debris loads (Photograph 4.11 and Photograph 4.12), limited hydrological heterogeneity and low macrophyte and periphyton mass. The Overburden Tributary had more effective shading from topography and regenerating vegetation, reflected in its high SEV score of 0.67, compared with 0.44 for Site 5B.

SEV sites 'Stream 3 East' and 'West' are hard-bottomed and exhibit high hydrological heterogeneity relative to their size, with runs, riffles, pools and chutes and a diverse substrate assemblage. Stream 3 East scored 0.70, indicative of a high ecological value despite being located within felled forestry, and is distinguished by its larger channel with relatively shallow sloping banks, moderate to high shading and regenerating riparian vegetation. Stream 3 West was distinct in having a shallow-gradient profile, a relatively wide floodplain of approximately 3 m on either side, sparse riparian vegetation, very low shading and reduced forestry slash. It transitions upstream into a steep chute and waterfall approximately 200 m long and had an SEV score of 0.58, indicative of moderate value.

Streams within the bush covenant area in the upper eastern Stream 3 catchment are intermittent, with some spring-fed flows, and are associated with mature native riparian vegetation (Photograph 4.13). Streams were soft-bottomed with some gravels and cobbles, highly shaded and approximately 0.3 m wide in the upper reaches and up to 0.7 m wide in the lower reaches. Although no SEV was undertaken, these conditions are considered comparable to the high-value Stream 1 SEA tributary.



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Photograph 4.11: Catchment overview of Stream 3 5B SEV site, looking downstream. The stream channel is obscured by forestry slash. Photograph taken 4 September 2025.



Photograph 4.12: Stream 3 Overburden SEV site, looking upstream. Photograph taken 15 October 2025.



Photograph 4.13: Stream 3 tributary upper reach within the bush covenant area. The small stream channel with soft-bottom and gravel/cobble substrates is visible in the bottom centre of the photograph. Photograph taken 16 October 2025.

4.2.1.5 Wairoa River

The Wairoa River is the second largest river in the Auckland region[19] and is the receiving environment for the proposed quarry expansion. It is a fifth order stream and flows in a northeasterly direction towards the Tāmaki Strait. The catchment is predominantly rural with some tributaries extending into the forested Hunua Ranges.

The Wairoa River Catchment Management Strategy (Blackford, 2002) highlights key issues including increased flooding from forest clearance and urbanisation, reduced low flows due to damming and water abstraction, and declining water quality from sediment, erosion, and farming practices. Sedimentation in the lower river and estuary is noted as a major problem, smothering aquatic habitats, hindering fauna movement, and promoting nuisance weed growth.

Monitoring of the Auckland Council Wairoa River monitoring site[20] indicates that QMCI values are typically poor, while MCI values are generally moderate[19]. Low scoring is likely due to the predominantly rural catchment land use at this location.

4.2.2 Fauna

Macroinvertebrates

Macroinvertebrate results from sampling undertaken across Stream catchments 1, 2, 2a and 3 are presented in Appendix H. The results indicate that stream ecological health is generally good to excellent, with reference to quality class thresholds (Stark & Maxted, 2007a), although there are

[19] LAWA – Wairoa River (Auckland Region) Site Page: https://www.lawa.org.nz/explore-data/auckland-region/river-quality/wairoa-river/, accessed on 23 January 2026.

[20] Located in the mid-catchment, approximately 5 km downstream of the proposed quarry expansion footprint and approximately 13 km inland from the coast.

clear differences between sites and evidence of localised degradation at some more highly disturbed locations.

Results from macroinvertebrate sampling in the Stream 1 SEA Tributary were indicative of 'excellent' stream ecological health. Although only four EPT taxa were identified, representing a moderate EPT richness of 33.33%, these sensitive taxa comprised 48.37% of the total abundance, indicating that they were a substantial component of the sampled community. The excellent soft-bottomed MCI and QMCI scores suggest that the site supports a diverse and pollution-sensitive macroinvertebrate community, consistent with favourable habitat and water-quality conditions.

Results from Stream 2 demonstrate variability between sites. The upstream site MCI-sb and QMCI-sb reflected excellent stream ecological health, despite having fewer EPT taxa than the downstream site. This may reflect differences in stream substrate and habitat availability rather than poorer ecological condition. In contrast, the downstream site supported a greater number of EPT taxa overall, with ten taxa identified, but its MCI/MCI-sb (reflected fair/good stream ecological health, respectively) and QMCI/QMCI-sb (both reflected poor stream ecological health) results differed substantially. The MCI values suggests that taxonomic diversity was relatively high, whereas the poor QMCI indicates that the community was dominated by less-sensitive taxa and had a poorer overall composition. This combination is consistent with a system experiencing some degree of degradation. The unsampled Stream 2 regenerating bush site would be expected to support better results than the sampled reaches, likely similar to the Stream 2a results (below), given its greater riparian cover and reduced fine-sediment influence.

Stream 2a had high EPT results, with six EPT taxa representing 60% of taxa richness and 92.11% of total abundance. Its MCI classification reflected good stream ecological health, while its QMCI classification was excellent, indicating a community dominated by pollution-sensitive taxa and generally high habitat quality. This likely reflects that the reach was sampled at the downstream end of Stream 2a, within existing regenerating riparian vegetation rather than within the felled forestry area (Table 3.1).

The Stream 3 Overburden site also supported a healthy macroinvertebrate community, with six EPT taxa, an EPT richness of 42.86%, and MCI and QMCI classifications of excellent and good stream ecological health, respectively. This may be due to the higher levels of riparian cover at this site compared to other sites within the recently felled forestry area.

The lowest overall results were recorded at Stream 3 Site 5B. EPT richness was only 6.67%, and EPT abundance was extremely low at 0.84%. The MCI-sb score of 77.20 and QMCI-sb score of 3.36 were both indicative of poor stream ecological health. However, sampling at Site 5B was constrained by limited water and a lack of suitable, accessible habitat within the stream channel, which may have contributed to the low results. If these sampling constraints had not been present, MCI values may have been higher, although they would still be expected to be lower than those recorded at reaches with established riparian cover. For example, the higher values of the nearby Stream 3 Overburden site may have been due to more favourable habitat condition, potentially associated with differences in disturbance, sedimentation and riparian condition.

Fish and large freshwater invertebrates

Results from the review of existing freshwater fish and fauna records and eDNA surveys are presented in Appendix I. eDNA laboratory results are provided in Appendix J.

Results indicated that the lower reaches of Stream 1 support a diverse fish community, including longfin eel (*Anguilla dieffenbachia*), shortfin eel (*Anguilla australis*), banded kōkopu (*Galaxias fasciatus*), torrentfish (*Cheimarrichthys fosteri*) and redfin bully (*Gobiomorphus huttoni*). Kōura (*Paranephrops planifrons*) was also detected at trace levels in eDNA sampling and confirmed in tributaries via visual observation. Longfin eel, banded kōkopu, torrentfish and redfin bully are the

key species present that are of conservation value, with Nationally and/or Regionally 'At Risk' threat statuses (Appendix I). Torrentfish were detected in eDNA surveys and have a Regionally 'Threatened – Vulnerable' status. Waterfalls are likely to limit fish access to the upper catchment, where the species detected were limited to good climbers such as eels and banded kōkopu.

The lower reaches of Stream 2 support banded kōkopu, shortfin eel, longfin eel and kōura, based on previous electric fishing and eDNA results. Fish presence is likely to be concentrated in the lower to mid-catchment and larger tributaries, with waterfalls restricting distribution in the upper catchment. Notwithstanding this the species present have good climbing abilities and may be present in small numbers in the lower catchment, noting that available habitat is limited in this part of the catchment due to low flows. Longfin eel and banded kōkopu are the key fish values based on conservation status.

eDNA surveys in Stream 2a detected shortfin eel and kōura in the lower reaches. This indicates a relatively limited fish assemblage at the sampled site. The limited detections may reflect the fish passage constraints caused by the perched culvert at the downstream extent of the reach limiting connectivity to the Wairoa River. Fish habitat was also observed to be limited within this stream, due to the small size of the stream, as is expected for an intermittent headwater stream.

The lower reaches of Stream 3 support the most diverse assemblage of the four catchments surveyed, including inanga (*Galaxias maculatus*), torrentfish, longfin eel, redfin bully, banded kōkopu, shortfin eel and rainbow trout (*Oncorhynchus mykiss*), with kōura also detected. Inanga, torrentfish, longfin eel and redfin bully are the key high-value species based on conservation status. Fewer species were detected in the eDNA sample taken further upstream in the main channel, likely because of waterfalls that restrict fish passage.

Common smelt (*Retropinna retropinna*) and kōaro (*Galaxias brevipinnis*), both Regionally 'Threatened', were detected at trace levels in the downstream and upstream Stream 3 main channel eDNA survey locations, respectively. These should be treated as potential rather than confirmed occurrences. Further surveys would be required to more reliably assess the presence of these species. However, for the purposes of this assessment, both species were assumed to be present in the relative eDNA sample locations.

Stream 3 tributaries were not surveyed for fish, however due to the steep catchment and presence of natural fish passage barriers, the fish community is expected to be limited to good climbers, such as eel species and banded kōkopu. Kōaro would also be able to access the upper catchment and tributaries. If present, kōaro would likely be limited to larger, faster flowing tributaries, such as the main reach through the OBDA, and less likely to be present in small intermittent headwater tributaries where suitable habitat is highly limited and sediment loads are high. Banded kōkopu may be present in isolated pools in intermittent streams, however due to the steep and small nature of the intermittent headwater streams within this catchment, this is likely to be limited to the lower reaches of intermittent streams.

Fish diversity and species values (based on conservation status) are greatest in the lower reaches of Streams 1 and 3, where connectivity with the Wairoa River supports a diverse diadromous fish assemblage. In comparison, Streams 2 and 2a support reduced communities. The presence of partial artificial fish passage barriers in the downstream reaches and waterfalls are considered key factors limiting fish distribution into the upper catchments.

4.2.3 Freshwater ecological values

The freshwater ecological values and species values of the catchments surveyed are summarised below, in respect of the characteristics and survey results described above, and the EcIAG criteria (Appendix C Table 1 and Appendix C Table 4). An assessment of potential ecological values is also presented below.

Stream 1 main channel

- **Ecological function**
  - **Current – High:** The hard-bottomed, permanent channel has a continuous native riparian zone through much of the catchment, providing strong shading and diverse, abundant and good-quality instream habitat, as reflected in high SEV value.
  - **Potential – High**: While most of the main channel catchment is within SEA-designated vegetation, near-reference conditions are unlikely to develop due to the existing quarry footprint being located within the catchment, adjacent to the true left bank of the mid to lower-reaches.
- **Species value – Very high:** The channel supports a diverse fish community, including torrentfish and redfin bully, as well as longfin and shortfin eels. The presence of regionally threatened and at-risk species supports a very high fauna value.

Stream 1 tributaries

- **Ecological function**
  - **Current – High:** The tributaries are generally well shaded by regenerating native vegetation and/or pine, with good hydrological heterogeneity and instream habitat, and correspondingly high SEV values. Their current value is reduced by unnatural sediment loading.
  - **Potential – High to Very High:** Where the potential for tributaries to reach reference condition is limited by their ephemeral headwaters being lost to the existing quarry footprint, potential value is considered **High**. It is expected that tributaries within SEA-designated vegetation may reach near-reference condition in the future, as the existing SEA vegetation matures, although evidence of past land use activity may remain for some time, therefore potential values are considered **High** to **Very High**.
- **Species value – High:** Fish communities are dominated by good-climbing species, including longfin and shortfin eels. Torrentfish are not expected in the upper tributaries because of steep gradients, natural barriers and limited climbing ability.

Stream 2 main channel

- **Ecological function**
  - **Current – Moderate to High:** The upper reach is considered to have **Moderate** value as it is affected by forestry-derived sediment and limited riparian cover, whereas the lower reach has **High** ecological function due to better riparian vegetation and less channel modification due to forestry activity. This is reflected in the SEV values for this catchment, which range between moderate and high.
  - **Potential – High**: Although most of Stream 2 is located within the SPQZ, indicating the anticipated use of this area for quarrying activities, for the purposes of this ecological assessment it was assumed that, in the absence of the proposed quarry expansion, the current exotic forestry land use will continue. As such, the potential future values for the reaches currently within felled forest are considered to be High, while the current values of the lower reaches are unlikely to improve further and potential values are considered to remain **High**.
- **Species value – High:** The channel supports longfin eel, banded kōkopu and shortfin eel. These are good-climbing species and are therefore likely to access the upper reaches, although their distribution will be limited by availability of suitable habitat and flows.

Stream 2a

- **Ecological function**
  - **Current – Moderate to High:** Most of the stream, upstream of the exotic/native regenerating bush, shows **Moderate** ecological function because recent pine felling has resulted in high sediment loading and limited riparian cover. The lower reach is well vegetated and is considered to have **High** value, and this is reflected in the high EPT abundance and 'good' and 'excellent' MCI and QMI values, but the wider catchment land use and corresponding low SEV score limits assigning a higher value.
  - **Potential – High:** It is considered likely that, in the absence of the proposed quarry expansion, the current exotic forestry landuse will continue. Similarly to Stream 2, the potential future values are therefore expected to be unlikely to reach reference quality and will remain **High** at most.
- **Species value – Low:** Freshwater fauna records are limited to shortfin eel, a species classified as Not Threatened.

Stream 3 main channel

- **Ecological function**
  - **Current – Moderate to High:** Ecological function is **Moderate** through forestry-affected reaches due to sediment inputs and reduced shading having degraded habitat, and because SEV value is moderate/high. Value is considered **High** through the main channel remnant native bush section.
  - **Potential – High:** As for the Stream 2 and 2a, it is expected that the current forestry activity will continue in this catchment in the absence of the proposed quarry expansion and ecosystem function values will remain **High** at most.
- **Species value – High to very high:** The lower catchment supports torrentfish, inanga and redfin bully, resulting in very high fauna value. The lower-mid catchment supports longfin eel and banded kōkopu and is assessed as high in species value. Common smelt may also be present as indicated by trace eDNA detection.

Stream 3 tributaries

- **Ecological function**
  - **Current – Moderate to high:** Tributaries affected by forestry sediment and limited riparian vegetation have **Moderate** ecological function, while those within the protected native forest remnant are expected to have **High** function because of intact native vegetation and shading. The overburden site had MCI and QMCI classifications of 'excellent' and 'good', typical of very high ecological function value, although SEV values and surrounding land use reflect high value.
  - **Potential – High:** It is expected that the current forestry activity will continue in this catchment in the absence of the proposed quarry expansion and ecosystem function values will remain **High** at most
- **Species value – High to very high:** The tributaries are likely to support longfin eel and banded kōkopu, which are good climbers and may access tributary habitat from the lower-mid catchment. The Regionally 'Threatened' kōaro may also be present although presence would be limited to larger, faster flowing tributaries with lower sediment loads.

Wairoa River

- **Ecological function**

  - **Current – Moderate:** The mid-reaches near the potential impact area are expected to have moderate ecological function based on available desktop information and the EcIAG criteria.
  - **Potential – Moderate:** The wider Wairoa River catchment is heavily modified due to agricultural land use, which is unlikely to change substantially in the future. As such, the potential value is expected to remain unchanged from the current.
- **Species value – Very high:** The Wairoa River is considered to have very high freshwater fauna value, reflecting its importance as a larger receiving environment and its potential to support a diverse fish community, including threatened and at-risk species.

4.3 Summary of ecological values

A summary of terrestrial and freshwater ecological values is presented in Table 4.4 and Table 4.5, respectively.

Table 4.4: Summary of terrestrial ecological values recorded at the site

Feature	Ecological value
King fern	High
Regenerating tree fern/broadleaf forest	High
Cutover pine	Negligible
Kānuka-tree privet treeland	Low
Exotic shrubland	Low
Mixed broadleaf forest	Very High
Mixed broadleaf treeland	High
‘Not Threatened’ native avifauna	Low
Hochstetter’s frog	High
Long-tailed bat	Very High

Table 4.5: Summary of freshwater ecological values

Watercourse	Current ecological function value (Potential value)	Fauna value
Stream 1 main channel	High (High)	Very High
Stream 1 tributaries	High (High to Very High)	High
Stream 2 main channel	Moderate to High (High)	High
Stream 2a	Moderate to High (High)	Low
Stream 3 main channel	Moderate to High (High)	High to Very High
Stream 3 tributaries	Moderate to High (High)	High to Very High
Wairoa River	Moderate (Moderate)	Very High

5 Assessment of terrestrial effects and effects management

This section describes the potential effects of the project on terrestrial ecology during the quarry footprint expansion (including enabling and establishment works and OBDA creation) and quarry operation. As noted in earlier sections, the expansion would occur progressively over an estimated 50-year timeframe.

The potential adverse effects on terrestrial habitats and fauna due to the proposed works outlined in Section 2 have been identified as:

- Permanent loss of 6.1 ha of native regenerating tree fern/broadleaf forest.
- Permanent loss of 0.5 ha of tree privet-kānuka treeland.
- Edge effects on native vegetation outside of the quarry footprint.
- Loss of 'At Risk-Declining' king fern during vegetation clearance.
- Injury or mortality of native fauna.
- Disturbance of native fauna during vegetation clearance and quarry operation.

These adverse effects are assessed in more detail in the following sections.

5.1 Permanent loss of terrestrial vegetation and fauna habitat

The proposed works will result in the permanent loss of terrestrial vegetation and fauna habitat across the project site. Works are expected to be staged across a 50-year period, with expansion of the quarry occurring across five indicative stages. Table 5.1 summarises approximate vegetation loss by the proposed expansion stage. At the conclusion of works, all vegetation within the impact areas will be removed. All vegetation types within the impact area are well-represented both within the surrounding area and at a regional scale. As such, although the loss is permanent, vegetation loss is considered to represent a **moderate** magnitude of effect.

Table 5.1: Total approximate vegetation loss across expansion stages

Indicative Expansion stage	Approximate Vegetation loss (ha)			
	Regenerating tree fern/broadleaf forest	Cutover pine	Tree privet/kānuka treeland	Exotic shrubland
Stage 1 (years 0-10)	0.0	2.8	0.5[21]	2.0
Stage 2* (years 10-30)	0.2	16.2	0.0	0.0
Stage 3* (years 10-30)	0.0	15.9	0.0	0.0
Stage 4 (years 30-40)	3.0	11.8	0.0	0.0
Stage 5 (years 40-50)	2.9	5.9	0.0	0.0
Overburden (years 0-10)	0.0	4.6	0.0	0.0
Total	**6.1**	**57.1**	**0.5**	**2.0**

[21] Removal previously authorized under the 2018 Consent.

5.1.1 Regenerating tree fern/broadleaf forest

5.1.1.1 Overview

Approximately 6.1 ha of regenerating tree fern/broadleaf forest within an SEA overlay will be removed. This vegetation is dominated by native species, and it is a good example of a mid-successional native ecosystem that has developed from pasture over approximately 60 years. One nationally and regionally 'At Risk' plant species is present within this forest, and the vegetation currently provides confirmed habitat for a range of native bird species. In future it may also provide habitat for 'At Risk' native bird species including North Island kākā if suitable nesting cavities develop. Long-tailed bats forage across this vegetation type and a large pine on the edge of the forest provides potential roosting habitat.

This vegetation type is considered to have **high** ecological value. A high ecological value combined with a **moderate** magnitude of effect leads to an overall level of effect of **high**. As outlined in Section 2.3, efforts have been made to avoid impacting this vegetation as much as possible. However, there are no further options to reduce the quantum of vegetation clearance and therefore ecological offset is recommended to address residual ecological effects.

5.1.1.2 Residual effects management

Two BOAMs were developed to determine an appropriate quantum of restoration to address the residual effects associated with the loss of regenerating tree fern/broadleaf forest. Both models comprised four biodiversity components (canopy, diversity, understorey, and fauna habitat and food provision), with up to three biodiversity attributes (e.g. cover, average height, diversity of native vascular plants) assessed within each biodiversity component. Published literature was used to provide a benchmark for each biodiversity attribute. Impacts in both models are addressed through the provision of planting and pest plant control, and the restoration target forest type is WF9 (taraire, tawa, podocarp forest) based on the forest type present in the protected native forest remnant.

Justification tables for each BOAM are provided in Appendix K, with key results summarised below.

<u>BOAM1 - OBDA</u>

A 4.6 ha OBDA is proposed as part of the quarry expansion. It is anticipated that this will be filled within approximately 10 years and it will be available for restoration planting from bare earth once full.

A standard discount rate of 0.03 was used to reflect the time lag between the commencement of consent and restoration being undertaken. This discount rate also accounts for the restoration taking place closer to time of impact than the restoration of the Stream 3 catchment (see below). Restoration will be undertaken using standard best-practice methods in an area with good soil and growing conditions so confidence in offset actions has been set as "very confident".

The model determined that planting the full 4.6 ha OBDA is sufficient offset for the loss of 2.0 ha of regenerating tree fern/broadleaf forest. Model results are summarised in Table 5.2 with a full justification table provided in Appendix K.

Table 5.2: BOAM1 summary – planting of OBDA at year 10

Biodiversity component	Biodiversity attribute	Biodiversity value at offset site	Biodiversity value at impact site	Attribute net present biodiversity value	Component net present biodiversity value
Indigenous canopy	Canopy cover (%)	2.92	-1.40	1.52	**0.19**
	Average height of indigenous canopy (m)	0.94	-0.93	0.01	
	Basal area (m^2/ha)	1.05	-2.00	-0.95	
Indigenous diversity	Diversity of native vascular plants	1.39	-1.09	0.30	**0.30**
Indigenous understory	Percentage cover of indigenous understory vegetation (%)	1.53	-1.00	0.53	**0.53**
Fauna habitat provision	Coarse woody debris (m^3/ha)	1.69	-0.02	1.66	**0.86**
	Average leaf litter depth (mm)	1.32	-1.25	0.07	

BOAM2 – Stream 3 catchment restoration

The BOAM2 model was designed to address the remaining residual effects of the loss of 4.1 ha of regenerating tree fern/broadleaf forest following BOAM1 offset actions described above. For this model, the area of offset adjusted in offset model to achieve no net loss outcome. Restoration planting for BOAM2 will occur in the upper reaches of the Stream 3 catchment, where it will form part of a catchment-wide effects management package (see Section 7.1).

A discount rate of 0 was applied because the restoration will be undertaken within 1 year of commencement of consent, whereas the impact is not anticipated to occur for 20+ years. Standard restoration methods will be used so confidence in offset actions is set as “very confident” for all. All existing exotic vegetation will be sprayed prior to planting; however, coarse woody debris (pine slash) will be left in place where possible so coarse woody debris values are included in the offset calculation.

The model determined that restoration planting of 6.0 ha is sufficient to offset the loss of 4.1 ha of regenerating tree fern/broadleaf forest. Model results are summarised in Table 5.3 with a full justification table provided in Appendix K.

Table 5.3: BOAM2 summary – planting of Stream 3 catchment at year 1

Biodiversity component	Biodiversity attribute	Biodiversity value at offset site	Biodiversity value at impact site	Attribute net present biodiversity value	Component net present biodiversity value
Indigenous canopy	Canopy cover (%)	5.09	-2.87	2.22	**0.19**
	Average height of indigenous canopy (m)	1.91	-1.91	0.00	
	Basal area (m^2/ha)	2.46	-4.10	**-1.64**	
Indigenous diversity	Diversity of native vascular plants	3.26	-2.24	1.02	**0.30**
Indigenous understory	Percentage cover of indigenous understory vegetation (%)	1.53	-1.00	0.53	**0.53**
Fauna habitat provision	Coarse woody debris (m^3/ha)	1.69	-0.02	1.66	**0.86**
	Average leaf litter depth (mm)	1.32	-1.25	0.07	

Summary

In summary, 10.6 ha of restoration planting is proposed to offset the loss of 6.1 ha of regenerating tree fern/broadleaf forest. Of this, 6.0 ha will be undertaken within one year of commencement of consent and 4.6 ha will be undertaken approximately 10 years after commencement of consent . Approximately 0.2 ha of regenerating tree fern/broadleaf forest will be removed in Stage 2 (10-30 years after consent is granted) with the remainder occurring in Stages 4 and 5 (30-50 years after consent is granted). All offset planting will be completed in advance of impacts and offset gains are anticipated to be fully realised within 10-25 years of planting. Both BOAMs indicate that full implementation of the offset outlined above will result in a net gain in biodiversity values.

Further detail regarding the residual effects management measures is provided in Section 7.

5.1.2 Cutover pine

Most of the vegetation that will be lost (55.4 ha in total) comprises cutover and replanted pine forest with scattered mostly exotic shrubs. This vegetation type has been assigned an ecological value of **negligible** due to being significantly modified through forestry activities, being dominated by exotic species, and not providing habitat for any indigenous fauna species. A **negligible** ecological value combined with a **moderate** magnitude of effect leads to an overall level of effect of removing this vegetation of **low**. Given the negligible ecological value and the overall level of effect of low, no effects management is proposed for the loss of this vegetation type.

5.1.3 Tree privet-kānuka treeland

As discussed, in Section 4.1.1.3, the 2018 consent authorised the removal of 0.5 ha of tree privet-kānuka treeland which has not yet been undertaken. This vegetation has been assessed as having **low** ecological value due to the provision of potential nesting habitat for native birds. A low ecological value combined with a **moderate** level of effect results in an overall level of effect of **low.** To mitigate the effect of this vegetation loss, Conditions 50 and 51 of the 2018 consent require the planting of 600 m² of native vegetation along the true left riparian margin of the northern stream in accordance with an approved planting plan. This planting has also not yet been undertaken. It is proposed that these conditions be removed from the varied 2018 consent, with the vegetation removal and corresponding mitigation planting instead authorised and managed through the proposed Quarry Expansion consent. The proposed mitigation planting area remains unchanged.

5.1.4 Exotic shrubland

Exotic shrubland has been assessed as having an ecological value of **low** due to providing potential nesting habitat for native birds. A low ecological value combined with a **moderate** level of effect results in an overall level of effect of **low**. Given the low ecological value and the overall level of effect of low, no effects management is proposed for the loss of this vegetation type.

5.2 Edge effects

Removal of regenerating tree fern/broadleaf forest for the quarry expansion will increase the exposure of retained native vegetation within the SEA overlay on the edge of the quarry footprint to wind and sunlight. Retained native vegetation at the newly created edge may experience increased moisture stress, canopy dieback, and changes in understorey composition through reduced recruitment. Increased wind exposure can also cause branch breakage, tree fall, and desiccation, while altered light conditions may favour disturbance-tolerant exotic species over native species adapted to interior habitat conditions.

Vegetation within the SEA overlay comprises common pioneer species that are adapted to growing in exposed conditions. As a result, the vegetation is less likely to be impacted by edge effects than mature forest types. Any potential edge effects are also only likely to be apparent in the first 10 m from the edge. At the end of Stage 5, the newly created SEA edge will be around 600 m in length and minor edge effects may be observed across an area of approximately 0.6 ha. There is over 100 ha of regenerating tree fern/broadleaf forest in the immediate vicinity of the site and the magnitude of effect of edge effects on retained native vegetation is considered to be **low**. Native vegetation within the SEA overlay has been assigned an ecological value of **high**, leading to an overall level of effect of **low**. No effects management is proposed to address edge effects.

5.3 Loss of ‘At Risk’ plants

King fern (nationally and regionally ‘At Risk’) have been recorded within the impact area. This species is considered to have a **high** ecological value due to its conservation status and therefore efforts will be made to minimise adverse effects by transplanting individual plants to appropriate habitat outside of the impact area where practicable. Plants will either be transplanted within contiguous forest outside of the impact area or within offset plantings if a suitably experienced ecologist considers the plantings are sufficiently mature to provide suitable environment for the species. King fern was recorded within the protected native forest remnant, within the SEA outside of the impact area, and the iNaturalist database holds over 20 records of king fern from locations within approximately 10 km of the site. Therefore, loss of individual plants within the impact area will not have an adverse effect on the species at a population level and the magnitude of effect of vegetation clearance on king fern is considered **low**. A low magnitude of effect combined with a high ecological value leads to an overall level of effect of **low**.

5.4 Injury or mortality of indigenous fauna

Vegetation clearance activities and earthworks have the potential to cause accidental injury and mortality to indigenous 'Not Threatened' and 'At Risk' birds and 'Threatened – Nationally Critical' long-tailed bats. All indigenous birds and bats, regardless of conservation status are protected under the Wildlife Act 1953, administered by Department of Conservation (DOC), and therefore measures to avoid injury/mortality immediately prior to and during construction are recommended.

Without effects management measures, there is the potential for bird and bat injury or mortality during vegetation clearance. For the common and widespread bird species that are present at the site, injury or mortality is not likely to have a population-level impact and therefore the magnitude of effect for birds is considered to be **low**. The magnitude of effect for bats is considered to be **moderate**, in that felling without effects management could impact a moderate proportion of the known population of the species. Frog habitat mapping confirmed that no potential frog habitat will be directly impacted due to vegetation clearance (Appendix A Figure 5). As such, there will be no risk of Hochstetter's frogs being killed or injured during vegetation clearance or stream reclamation.

5.4.1 Birds

The regenerating tree fern/broadleaf forest, exotic shrubland, and tree privet-kānuka treeland provide potential habitat for a range of bird species, which may be killed or injured during vegetation clearance. Adult birds are mobile and able to move out of harm's way during vegetation clearance so are unlikely to be injured or killed. However, eggs and chicks in nests are at risk of direct harm if works are undertaken during peak bird breeding season (September to January, inclusive). Without any effects management measures in place, the magnitude of effect on native birds could potentially be **low**.

Potential adverse effects can largely be avoided by undertaking vegetation clearance outside of peak breeding season (September to January, inclusive). If it is not possible to avoid peak breeding season, the risk of damaging an occupied nest can be minimised through undertaking nest surveys no more than 48 hours prior to vegetation clearance. These surveys may require trees to be climbed if tree cavities are observed that provide potential nesting habitat for species such as ruru (*Ninox novaeseelandiae*, 'Not Threatened') or kākā (*Nestor meridionalis*; 'At Risk-Recovering'). Preparation and implementation of an Avifauna Management Plan (AMP) detailing best practice measures for bird management is recommended prior to vegetation removal. Given the extended duration of the project, and the likelihood that vegetation clearance will occur in stages over time, the AMP should be reviewed no more than 6 months before each substantive phase of vegetation clearance. Where required, the AMP should be updated to ensure management measures are still appropriate for the habitats and bird species present at the time. A draft AMP has been prepared and is attached to the substantive application.

Implementation of best-practice measures for bird management will reduce the magnitude of effect of incidental injury and mortality to **negligible**. Considering the ecological values alongside the magnitude of effect, in the potential overall effects on avifauna is considered to be **very low** for all bird species that may be present.

5.4.2 Bats

Long-tailed bat presence has been confirmed at the site. As discussed in Section 4.1.3.4, there is currently only one potential roost tree within the impact footprint (Appendix A Figure 6); however, activity recorded at this tree was very low and there was no activity indicative of roosting observed. Trees within the regenerating tree fern/broadleaf forest do not currently provide roosting habitat; however, roosting habitat may develop as the vegetation matures leading to potential injury or mortality of bats if occupied roost trees are felled.

Without any effects management measures in place, the magnitude of effect on native long-tailed bats could potentially be **high**.

Preparation and implementation of a Bat Management Plan (BMP) detailing best practice measures for bat management is recommended prior to vegetation removal. Given the extended duration of the project, and the likelihood that vegetation clearance will occur in stages over time, the BMP should be reviewed no more than 6 months before each substantive phase of vegetation clearance. Where required, the BMP should be updated to ensure management measures are in line with current best practice. A draft BMP based on current best practice measures ('Bat Roost Protocols', DOC, 2024) has been prepared and is attached to the substantive application.

Through implementing a BMP, bat injury and mortality from tree clearance will be largely avoided. As a result, the magnitude of effects has been classed as **low**. Long-tailed bats have a conservation status of 'Threatened-Nationally Critical' and are therefore considered to have very high ecological value. Following the EcIAG framework results in an overall level of effect of **moderate**. However, conservation status of a species does not impact the effectiveness of management measures, and the overall level of effect is considered to be **very low.**

5.5 Disturbance effects on indigenous fauna

5.5.1 Birds

The native bird species either confirmed or potentially present in habitats surrounding the existing quarry footprint are frequently found in urban areas indicating high tolerance for disturbance. Expansion of the quarry and associated noise, vibration and light are not anticipated to result in increased level of disturbance to birds using habitats on the edge of the quarry footprint and the magnitude of effect of disturbance on birds is considered **negligible**. The ecological value of indigenous bird species that may be impacted ranges from **low** to **high**, resulting in an overall level of effect ranging from **very low** to **low.**

5.5.2 Frogs

As outlined in Section 5.4, no potential frog habitat in the southern tributary will be directly impacted by the project. However, groundwater drawdown will potentially lead to a reduction in baseflows in the main stem of Stream 1 and the southern tributary where potential frog habitat has been identified. Reduced baseflows, particularly in summer, may reduce habitat quality for Hochstetter's frogs, potentially leading to the habitat becoming unsuitable. Without effects management, the magnitude of effect of groundwater drawdown on frog habitat could be **moderate**.

Stream 1 is proposed to be augmented to maintain baseflows in accordance with the relevant consent conditions. Maintaining baseflows through augmentation is expected to minimise potential adverse effects on instream and riparian habitats associated with the main stem of Stream 1 that may support Hochstetter's frog.

Augmentation of the southern tributary is unlikely to be feasible, and groundwater drawdown may reduce the quantity and quality of frog habitat available in this tributary. Although no frogs were detected using eDNA at two survey locations on the southern tributary downstream of potential frog habitat, groundwater drawdown is not anticipated to impact these tributaries for at least 10 years.

5.5.3 Bats

Acoustic surveys have confirmed that long-tailed bats are using habitats around the existing quarry footprint indicating that the local bat population has adapted to the current disturbance regime (Appendix A Figure 6). If the quarry expansion leads to more overnight works, additional disturbance

caused by light and noise may have adverse effects on long-tailed bats, and in a worst-case scenario bats may abandon habitats surrounding the quarry. The magnitude of effect of disturbance on long-tailed bats is potentially **moderate** if they are forced to find alternative commuting routes or foraging grounds.

Lighting

Any required lighting, security or other, will be designed and operated, in accordance with the relevant permitted standards in the AUP and the existing and proposed consent conditions, so as not to cause any light spill or disturbance glare for occupiers of any other properties outside of the site. Lighting management measures will be outlined in the Quarry Management Plan (QMP), and the measures will include minimising light spill into the Stream 1 riparian margin and the offset area of Stream 3.

Lighting design will incorporate guidance from the Department of Conservation on how to minimise the impacts of artificial light on bats[22].

Preventing light spill into habitats outside of the quarry footprint will reduce the magnitude of effect of artificial light on bats to **negligible** leading to an overall level of effect of **low**.

Noise

Noise generated by overnight activities at the quarry may cause bats to abandon habitats immediately adjacent to the quarry footprint. There is evidence that road noise reduces bat activity (Borkin et al 2019); however, there is also evidence that bats become habituated to noise (Le Roux & Waas, 2012). Consideration of the duration and the frequency of noise events are important when assessing effects. At a site in the Waikato, monitoring was undertaken for 17 days before, during, and for eight days after noise disturbance lasting until 1 am on three consecutive nights (J MacKay, pers. obs.). Bat activity decreased significantly during the three nights of disturbance but quickly recovered once noise disturbance ceased indicating that the disturbance only caused a temporary change in behaviour.

Overnight work at Clevedon Quarry is already allowed for under existing consents and it will be undertaken on an occasional basis when there is sufficient demand for aggregate. Overnight works will be undertaken in accordance with the lower noise limits set in the existing and proposed consent conditions. As such, it is considered likely that any change in behaviour caused by overnight works (such as bats avoiding the edge of the quarry footprint) will only be temporary. If bats were to avoid habitats adjacent to the quarry during overnight works, there is sufficient habitat to the north and south of the quarry footprint to ensure that commuting and foraging behaviour is not impacted. As such, the magnitude of effect of noise disturbance on bats is considered to be **negligible** leading to an overall level of effect of **low**.

5.6 Summary of terrestrial effects

Ecological values recorded at the site range from negligible to very high. Implementation of best practice measures to manage effects means that for the most part, effects can be reduced to a very low to low level. Residual effects associated with the loss of regenerating tree fern/broadleaf will be offset to achieve a net gain in ecological values. Therefore, all adverse terrestrial ecological effects of the project can be appropriately managed.

Table 5.4 provides a summary of terrestrial effects.

[22] https://www.doc.govt.nz/globalassets/documents/conservation/native-animals/bats/bat-recovery/reduce-impact-artificial-light-pekapeka.pdf.

Table 5.4: Summary of terrestrial effects

Effect	Feature	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)
Permanent loss of terrestrial vegetation and fauna habitat	Regenerating tree fern/broadleaf forest (6.13 ha)	High	Moderate	• Quantum of vegetation clearance minimised through design. • No mitigation possible and offset is proposed to address residual effects.	High Offset to achieve net gain
	Cutover pine (57.06 ha)	Negligible	Moderate	• None required.	Low
	Tree privet-kānuka treeland (0.5 ha)	Low	Moderate	• Planting of 600 m^2 of native vegetation along the true left bank of Stream 1 as required under the existing 2018 consent conditions to be rolled over to the Quarry Expansion consent conditions.	Low
	Exotic shrubland (2.0 ha)	Low	Moderate	• None proposed	Low
Edge effects	Native forest outside of impact area	High	Low	• None required	Very Low
Loss of 'At Risk' plants	King fern (nationally and regionally 'At Risk')	High	Low	• Quantum of vegetation clearance minimised through design. • Where practicable individual king fern plants will be transplanted to contiguous forest outside of the impact area or into offset planting areas.	Low

Effect	Feature	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)
Injury or mortality of native fauna	Native avifauna	Low to High	Low	• Implement bird management measures to minimise the risk of killing or injuring birds, particularly in nesting birds during peak bird breeding season (September to February).	Very Low
	Long-tailed bats	Very High	High	Implement Vegetation Removal Protocols during vegetation clearance to minimise risk of felling occupied roost trees	Very low
Disturbance effects on indigenous fauna	Birds	Low to High	Negligible	None proposed.	Very Low to Low
	Hochstetter's frogs	High	Potentially moderate	• Augmentation of the main stem of Stream 1 to minimise potential impacts •	Low
	Bats - light	Very High	Moderate	Lighting design that follows DOC guidelines and minimises light spill into habitats outside of the quarry.	Low
	Bats - noise	Very High	Negligible	None proposed.	Low

6 Assessment of freshwater effects and effects management

This section describes the potential effects of the project on freshwater ecology during the quarry expansion (including enabling and establishment works and OBDA creation) and quarry operation. As noted in earlier sections, the proposed expansion would occur progressively over an estimated 50-year timeframe.

The proposed works as described in Section 2 are expected to result in the following actual and potential ecological effects:

- Effects related to the expansion of the quarry:
  - Potential injury or mortality of terrestrial and freshwater fauna during works.
  - Permanent loss and/or modification of stream habitat (2,392 m across four catchments).
- Ongoing effects from quarry expansion and operation include:
  - Potential changes to stream flows.
  - Potential effects from the discharge and deposition of sediment in aquatic environments.
  - Potential water quality and scour and erosion effects on the receiving environment from the discharge of water runoff from the quarry footprint and flow augmentation.

The affected streams are mostly located within the existing forestry area, with some affected tributaries within the regenerating tree fern broadleaf forest. As outlined above, the proposed quarry expansion is intended to occur in five stages across approximately 50 years.

6.1 Injury and mortality of freshwater fauna

Injury and mortality of native freshwater fauna could occur if stream works were to take place in existing stream channels during expansion of the quarry and establishment of the OBDA. The magnitude of potential effect on native freshwater fauna is driven by the nature of the activity, the area of stream disturbance, density of fish present in each area, the ability of fish to escape disturbance and the controls applied. The conservation status of fish species, reflected in the fauna values assessment (Section 4.3) is also relevant when assessing the potential overall level of effect.

Works are expected to occur within approximately 2,392 m of permanent and intermittent stream within the quarry expansion footprint, which may result in injury and mortality of freshwater fauna.

Effects on freshwater fauna will be reduced through the implementation of a Freshwater Management Plan (FMP; provided in the draft EMP which is attached to the substantive application). The FMP details how freshwater fauna salvage and relocation will be undertaken to minimise, as much as practicable, injury and mortality effects on native freshwater fauna. It includes a toolbox approach to how freshwater fauna will be salvaged, with the final detail to be developed alongside the stream works methodologies prior to each stage of works occurring. Prior to any works occurring in streams or the diversion of flows from streams, freshwater fauna will be salvaged and relocated.

Intermittent streams are expected to provide less favourable habitat for native fish, and fauna are expected to migrate downstream to areas of continual flow during summer months. Undertaking stream dewatering and construction during summer months when these streams are dry is a way of reducing potential effects on freshwater fauna in these locations.

It is proposed that the FMP will be applied across the site, with intensity of effort in any given area dictated by the likelihood of ‘At risk’ species or type of habitat present. The FMP includes procedures and locations for:

- Recovery of fauna (including fish and kōura) prior to instream works;
- Measures to prevent fish returning to cleared areas;
- Rescue of fauna from spoil or dewatered materials;
- Relocation of fauna; and
- Reporting.

The FMP will give special consideration to access constraints for sites within the active forestry, to improve site and channel access for fish salvage, such as hand-removal of forestry slash prior to salvage where possible and creation of foot-access tracks.

In terms of assessing magnitude of effect, in **Stream catchments 1, 2a** and **3**, all streams to be removed are intermittent headwaters and are a relatively small proportion of the total habitat that may contain fish within those respective catchments (by stream length, 6% for Stream 1, 15% for Stream 2a, and 11% for Stream 3). As such, for these streams, without management measures in place, the magnitude of effect on species values at the scale of the impacted reach would be very high, as any fish present would be subject to injury or mortality, but the effect at the catchment scale would be considered at most **moderate**.

Additionally, compared to the larger downstream intermittent and permanent reaches within these catchments, which would have greater habitat availability, the relative abundance of fish within these headwater intermittent reaches would be low. This means that the proportion of individuals that are affected as a total of individuals in the catchment would be less than that indicated by stream length alone. Furthermore, with implementation of a NFMMP requiring works to be undertaken in summer where possible, intermittent streams will contain less habitat and the magnitude of effect can be reduced further.

If considered at the population scale, this would reduce even further, as the population of each species within each of the Stream catchments 1, 2a and 3 would be small compared to those in the wider Wairoa River catchment. In addition, fish presence has been further limited in Stream 2a due to there being downstream artificial fish passage barriers. However, assessment at each of the Stream 1, 2a and 3 catchment-scales is considered appropriate due to the unique assemblages of fish within each of the stream catchments.

Overall, even if no salvage can be implemented within these intermittent reaches due to access constraints, with the above considerations including undertaking streamworks in summer, the magnitude of effect is expected to be no greater than **low** at the catchment scale**.**

For **Stream 2**, the length of intermittent and permanent stream to be removed is approximately 60% and 20% of total intermittent and permanent stream length within the catchment, respectively. Without management measures in place, this would represent a **very high** magnitude of effect at the reach-scale and a high magnitude of effect at the catchment-scale. If fish salvage could not be implemented on **Stream 2 intermittent** streams due to site access, undertaking stream works in summer when intermittent streams are drier, as a management measure on its own, would reduce the potential habitat for fish and reduce the magnitude of effect to at most **moderate** at the catchment scale.

It is expected that fish salvage protocols can be implemented to a moderate proportion of the **Stream 2 permanent** reach, where the wider channel allows easier access to the channel for fauna salvage. As such, if the FMP is implemented in this part of the catchment, it is expected that the magnitude of effects can also be reduced to at most **moderate** at the catchment scale**.**

With the implementation of management measures as described above, the magnitude of effect can be managed to be **low** at most for Stream 1 tributaries, Stream 2a and Stream 3 tributaries**,** and the overall level of effect would be **very low** (Stream 2) to **low** (Stream 1 tributaries), **moderate** (Stream

3 tributaries). For Stream 2 intermittent and permanent streams, the magnitude of effect can be managed to **moderate**, with an overall **high** level of effect. The moderate and high levels of effect for Streams 2 and Stream 3 tributaries are due to species with a Nationally or Regionally 'At Risk' or 'Threatened' conservation status being present or potentially present. However, conservation status of a species does not impact the effectiveness of management measures, and the overall level of effect is considered to be **low**.

6.2 Permanent loss and/or modification of stream habitat

The proposed quarry expansion will result in the permanent loss (removal or reclamation) of permanent and intermittent stream habitat as summarised below (values rounded to the nearest metre below and throughout). This is due to these areas being located directly within the proposed life of quarry boundary or OBDA (Appendix A Figure 3):

- 344 m of intermittent headwater tributaries within the Stream 1 catchment;
- 999 m of intermittent and 334 m of permanent streams within the Stream 2 catchment;
- 78 m of the intermittent headwaters of Stream 2a; and
- 637 m of intermittent tributaries within the Stream 3 catchment (95 m within the life of quarry boundary and 543 m within the OBDA).

The presence of streams within the SPQZ means that quarry development cannot occur without some unavoidable freshwater habitat loss; however, the project has been designed to minimise freshwater habitat loss outside the quarry-zoned land as far as practicable (as described in Section 2.3). The remaining impacts are considered to be unavoidable and comprise the permanent loss of stream habitat of 2,392 m length (within the life of quarry and OBDA footprints), equivalent to an estimated streambed area of 1,182 m^2.

Works are expected to be staged across an approximately 50-year period, with expansion of the quarry footprint occurring in five indicative stages. Table 6.1 summarises stream loss by indicative expansion stage. At the conclusion of works, all streams within the impact areas will be removed.

Table 6.1: Stream loss across overburden site establishment and expansion stages

	Stream length (to nearest m) removed	Streambed area (to nearest m^2) removed
Overburden disposal area (~Stage 1)	543	205
Stage 1	69	21
Stage 2	104	32
Stage 3	966	670
Stage 4	507	208
Stage 5	204	47
Total	2,392	1,182

With respect to the EcIAG criteria (Appendix C), the permanent loss of intermittent and permanent stream habitat as a result of removal or reclamation within the life of quarry and OBDA footprints results in **a very high** magnitude of effect and a corresponding **high** to **very high** overall level of effect. This is based on the permanent loss of stream channel extent and values at the points of impact.

Remediation or further minimisation of effects at the point of impact are not possible as expansion of the quarry will remove existing streambed. Therefore, as described in the following section, offsetting actions are proposed which will offset a proportion of the residual effects on stream values to achieve a no net loss of ecological function. Compensation measures are proposed to address remaining residual effects on stream values, for which offset is not possible.

The NPS FM definition of aquatic offset includes values and extent. The approach to assessing values is set out above.

The site's steep terrain makes the creation of new streambed to address loss of stream channel extent impracticable, and the quarry expansion utilises the available land within the SPQZ, leaving no space for additional stream creation. Creating this stream length on private land or at an off-site location was also not considered practicable or preferable due to the complexities and uncertainties associated with obtaining landowner approval, securing ongoing access, and obtaining the necessary consents, notwithstanding the technical challenges with ensuring sufficient flow without having adverse impacts on other freshwater systems. Therefore, loss of stream extent is not addressed within this EcIA.

6.2.1 Residual effects management

A freshwater offsetting and compensation proposal has been prepared to address the above residual freshwater effects.

Stream 3 offset planting

Restoration planting of 20 m wide riparian margins is proposed along all intermittent and permanent stream reaches within the Stream 3 catchment, except for streams that will be removed within the quarry footprint or are assumed to become ephemeral due to loss of upstream catchment (refer to Section 6.3.1), and stream reaches within each of the two areas of existing native vegetation. This provides a total length of 4,510 m of intermittent and permanent stream (4,420 m^2 streambed area) available for offset.

For the purposes of determining the existing value[23] of the streams to be restored, representative SEVs were collected as described in Section 3.2.2.2. Potential values[24] were modelled, with detailed modelling assumptions provided in Appendix F. Modelling assumed full catchment planting in native vegetation except in areas where there are existing quarry activities.[25] ECR calculations were then applied for each paired impact/offset site until all available Stream 3 catchment offset streambed area was assigned.

Should consent be granted, all offset and compensation planting will be implemented as soon as is practicable following commencement of consent. As such, planting is proposed to be planted up to 50 years prior to impacts being realised, noting that approximately 57% of stream removal (by streambed area) within the life of quarry boundary is expected to occur within Stage 3 (20 to 30 years) and a further approximately 18% from Stage 3 (30 to 40 years) onwards (Appendix L).

The further in advance planting occurs prior to impact, the less relevant risks such as time-lag and failure are required to be accounted for. To reflect this, the 1.5 multiplier in the ECR formula (Section 3.3.2.2) was adjusted for impacts within a given stage in accordance with the number of years prior

[23] 'SEVm-C', refer to Appendix D ECR multiplier & staging assumptions.
[24] 'SEVm-P', refer to Appendix D ECR multiplier & staging assumptions.
[25] In contrast, the qualitative potential value presented Section 4.2 assumed continuation of current forestry activities. As reported in Storey et al. (2011), typical SEV scores for sites in this type of landuse in the Auckland region can range from moderate (e.g. 0.63) to very high (e.g. 0.91). The very high scores are comparable to those in native forest catchments (e.g. 0.89 to 0.96), therefore it was considered that the SEVm-P assumption applied in ECR calculations could also represent a scenario where exotic forestry landuse continued.

to the impact planting would occur. The multipliers that were applied are detailed in Appendix L with assumptions and rationale provided in Appendix D.

The proposed riparian planting of 4,510 m intermittent and permanent stream length (4,420 m^2 of streambed area) within the Stream 3 catchment offsets approximately 1,277 m stream length (737 m^2 of streambed area) of the total 2,392 m of stream loss effects (1,182 m^2 of streambed area) result from stream removal within the quarry expansion footprint and OBDA. Details are provided Appendix L – ECR calculations. It is noted that the offset stream length exceeds the total stream length lost, which meets the requirement of the SEV/ECR methodology that the length of stream restored must be at least equal to the stream length lost (Neale et al., 2011).

Stream 3 freshwater compensation planting

To determine the quantum of offset that would be required to address the remaining 445 m^2 of residual stream loss effects, if additional offsetting was undertaken offsite, the streambed area of a 'hypothetical' site was calculated. This is the 'additional site' presented in Appendix L – ECR calculations. The SEVm-C and SEVm-P scores for this 'additional site' were based on the average scores from across the Stream 3 offset sites, to provide SEV gains that were reflective of those expected across the Stream 3 sites. These calculations indicated that an additional 2,044 m^2 of 'additional site' streambed area would be required to offset the remaining 445 m^2.

No suitable locations within the site could be identified for offset of an additional 2,044 m^2 of streambed area. As such, freshwater compensation options were explored and it was identified that further planting within the Stream 3 catchment would provide an opportunity for additional improvement of streams within the catchment and through to the Wairoa River, via a 'ridge to river' approach.

To determine a quantum of freshwater compensation that might be appropriate, the 2,044 m^2 was converted to a stream length of 2,482 m based on an assumed wetted width of 0.75 m, which is comparable to the average wetted width of streams measured within the Stream 3 catchment (0.92 m). If this stream length was planted to 20 m on each bank of a stream of this length, this would equate to an area of riparian planting of 11 ha.

The potential location for this freshwater compensation planting within the Stream 3 catchment was carefully considered, to identify opportunities to maximise benefits to streams within the catchment and the Wairoa River as far as possible. Possible locations for the freshwater compensation planting to fulfil this objective were identified as follows:

- the upper half of the Stream 3 catchment could be fully planted from 'ridge to river', by forming a contiguous area of planting connecting freshwater offset planting with the terrestrial offset planting and the two areas of existing native vegetation (Appendix A Figure 8);
- the proposed 20 m riparian offset planting along the permanent and intermittent streams in the lower half of the Stream 3 catchment could be buffered by an additional 20 m wide strip of planting, creating a restored riparian margin that is a total of 40 m wide along each of those streams; and
- protection of the existing area of native vegetation, which would provide for the riparian margins of a total of 393 m of the Stream 3 main channel and one of its tributaries to be protected in perpetuity (Appendix A Figure 8).

It is acknowledged that the greatest benefits to streams of catchment planting are realised when that planting is adjacent to the recipient stream. The proposed freshwater compensation planting will be located adjacent to the freshwater offset planting, and as such will be located at least 20 m from the Stream 3 catchment stream margins. As such, a multiplier is considered appropriate, recognising that the aquatic ecology benefits of 11 ha of planting located within the 20 m riparian

margins of a stream may not have the equivalent benefit of 11 ha of catchment planting located outside of the 20 m riparian margin.

The total area of potential freshwater compensation planting in the first two areas bullet pointed above is 40.4 ha. As detailed in Section 6.3 below, an additional freshwater compensation planting area of 19 ha has been identified as being recommended to address changes in stream flows. Combined with the 11 ha for residual stream loss effects (30 ha total), the 40.4 ha available in the Stream 3 catchment is 1.3 times this area. This is considered an appropriate multiplier for applying to the area of riparian offset planting that would be planted at a hypothetical offset site with SEV gains similar to those expected at the Stream 3 offset sites.

As no accepted methods currently exist for quantifying the quantum of freshwater compensation required to achieve a positive improvement in biodiversity values that outweighs adverse effects, the SEV/ECR methodology has been used as a starting point, as described above, with the outputs of the calculation and professional judgement then applied in order to determine an appropriate quantum of compensation. The use of a biodiversity compensation model (BCM) was also considered, however, this methodology also relies on professional judgement and is challenging when considering non like for like trades therefore it was determined to be no more suitable than the above approach.

It is acknowledged that the proposed freshwater compensation planting is not a 'like for like' biodiversity exchange, however applying the methodology outlined above provides for an approach that considers both a quantum and professional judgement. Additionally, the NPS-FM principles for aquatic compensation have been applied as far as possible in development of the freshwater compensation component of the residual effects management package (Section 7, Appendix N). This approach is considered appropriate to compensate for the stream loss effects on the remaining 445 m^2 of stream not addressed by the proposed freshwater offset planting.

6.3 Changes to stream flows

Groundwater and hydrological investigations (WGA, August 2026; Tektus, June 2026) indicate that changes to stream flow regimes are expected to occur in some stream reaches as a result of:

- A reduction in contributing catchment area as the quarry footprint expansion removes the upstream portions of these affected catchments, and
- Changes in groundwater discharge to streams (stream depletion effects).

Each of these effects is discussed in the sections below.

6.3.1 Loss of contributing catchment area

Reduced stream flows are expected in some reaches of Stream 1, 2, 2a and 3 as the proposed expansion progressively removes a proportion of their upstream contributing catchment area. Potential effects on the freshwater ecological values of the affected streams include loss of aquatic habitat (e.g. reduced wetted channel area and depth), higher water temperatures and reduced dissolved oxygen levels, and increased nutrients, periphyton growth and sediment as the size and frequency of flood flows may be reduced.

Tektus Consultants Ltd. ('Tektus') modelled changes in stream hydrology, including contributing catchment area, before and after the proposed quarry expansion for streams within and surrounding the life of quarry boundary. For the current assessment, Tektus provided T+T with the post-quarry expansion (life of quarry extent) contributing catchment area[26] for individual modelled stream segments adjacent to and downstream of the life of quarry boundary. For T+T to be able to quantify

[26] '260616 Stream Hydrology R3' Results summary spreadsheet and PDF maps, provided to T+T by Tektus on 17 June 2026.

effects at a finer spatial resolution, Tektus divided each of its modelled stream segments (which in their original model generally began and ended at the point where two reaches converge) into four equal sub-segments and provided the pre- and post-expansion contributing catchment area for each of these sub-segments.

T+T reviewed the post-expansion catchment area for each sub-segment where it was in the same location as an intermittent or permanent stream mapped by T+T (Appendix A Figure 7). These fall into two key outcomes that are relevant to this assessment and are summarised below.

Post-expansion contributing catchment area reduced below intermittent stream flow threshold (<1.4 ha)

Where the pre-expansion upstream area of a given sub-segment changed from >1.4 ha[27] to <1.4 ha post-expansion, this was considered likely to result in a change from intermittent/ permanent to ephemeral stream flow. This effect was identified in a total of 1,533 m of stream (744 m^2 streambed area) within the upper reaches of the Stream 1 and Stream 3 catchments and the upper reaches of Stream 2a.

It is considered that without mitigation measures in place the magnitude of effects on intermittent and permanent stream reaches that will have a current catchment area of >1.4 ha reduced to **<1.4 ha post-expansion** will be **high**. This is because the shift from intermittent or permanent flow to ephemeral flow is considered to result in a major alteration in baseline conditions. The affected streams are small tributaries within the upper reaches of the Stream 1 and Stream 3 catchments and the upper reaches of Stream 2a. Combined with the freshwater ecological values for these sites, this magnitude of effect results in an overall **moderate** to **very high** level of effect.

Due to the nature of these streams being small headwaters, augmentation, which would be a key mitigation measure, is not considered practicable. Without augmentation, this potential effect cannot be further avoided, minimised or mitigated. These residual adverse effects are proposed to be addressed by freshwater compensation planting as part of the overall freshwater offsetting and compensation package, as outlined in Section 6.3.4.

Post-expansion contributing catchment area remains above intermittent stream flow threshold (>1.4 ha) but catchment area substantially reduced

The modelling results indicated that some sub-segments with a current catchment area of >1.4 ha will retain a catchment area of >1.4 ha following quarry expansion, however the pre-expansion catchment area remaining may be substantially reduced (percent change in area for affected catchments ranged between 9% and 92%[26], refer to Appendix M). Affected streams are within catchments 1, 2a, 2 and 3.

It is difficult to assess the extent to which a large change in catchment area would alter the existing baseline conditions at a reach-scale measure, and similarly it is difficult to determine a 'threshold' percentage change in catchment area that would result in a detectable change in baseline conditions.

Notwithstanding this, these stream reaches are expected to continue to flow at least intermittently because their catchment will remain >1.4 ha. However, flows may be substantially reduced and/or streams may be dry for longer periods of the year. While difficult to predict, it is expected that any shift away from baseline conditions that may occur will be minor to moderate (proportional to the percentage of catchment area reduction expected for that reach[28]) for streams in catchments 1, 2a, and 3, which corresponds to at most a **moderate** magnitude of effect without any management

[27] Based on the 1.4 ha contributing catchment area threshold to generate intermittent flow assumption used in the T+T stream classification GIS model (Section 3.2.2.1).

[28] Catchment area reductions shown in Appendix M were considered minor if 20% or below and moderate if greater than 20 %.

measures in place**.** Combined with the freshwater ecological values for each of these sites, this magnitude of effect results in an overall level of effect of **very low** to **moderate.**

Stream 2 reductions ranged from 63% to 92%, which were considered a **high** magnitude of effect, with a corresponding **moderate** to **very high** overall level of effect. The Stream 2 assessment is detailed further in the subsection immediately below.

Mitigation measures to reduce these effects further at the remaining sites are discussed in Section 6.3.3.

Effects on Stream 2 surface flows

The downstream remnant extent of the Stream 2 main channel that will not be removed by quarry expansion footprint is expected to lose up to 92% of its upstream contributing catchment (Appendix M). As this represents almost the entire upstream contributing catchment area, it was considered that this would likely result in major loss or alteration of the existing baseline condition for this remaining 341 m length of stream. Similarly, the one remaining tributary to Stream 2 that will be outside of the quarry expansion footprint (stream length 108 m) (Appendix A Figure 7) is expected to lose 63% of its upstream contributing catchment area, which was also assumed to result in a major loss or alteration of the existing baseline condition this remaining length of stream.

As outlined above, this equates to a **high** magnitude of effect and an overall **moderate** to **very high** level of effect. It was not considered feasible to augment flows to the remaining downstream reaches of Stream 2 and its remaining tributary. Without augmentation, this potential effect cannot be further avoided, minimised or mitigated. These residual adverse effects are proposed to be addressed by freshwater compensation planting as part of the overall freshwater offsetting and compensation package, as outlined in Section 6.3.4.

6.3.2 Reduced groundwater contributions

Wallbridge Gilbert Aztec (WGA) developed a three-dimensional (3D) numerical groundwater model based on site visits, piezometer data, geological review, and historic streamflow information, in order to assess potential groundwater and surface water effects of the proposed quarry expansion. A summary of key findings relevant to the assessment of freshwater effects is provided below. The detailed results of the modelling can be found in the Groundwater Assessment Report (August 2026; hereafter 'the WGA Assessment').

The WGA Assessment included a stream depletion assessment that used the groundwater model to estimate changes in groundwater discharge to streams at the Stage 1 and Stage 5 expansion designs. The assessment concluded that the proposed quarry designs would alter groundwater flow patterns and reduce baseflow contributions to nearby streams. It is noted that the predicted stream effects detailed in the WGA Assessment related to the changes in the groundwater contribution to baseflows/stream flow from the Regional Aquifer only and did not include direct rainfall runoff, stormflow, or other surface-water runoff components. Seasonal variability, droughts, storm events and year-to-year climate variability were not represented by the model.

Table 6.4 below places the WGA predicted reductions in stream flow for the Streams 1, 2a and 3 catchments[29] in the context of estimated Mean Annual Low Flows (MALF) presented in the WGA Assessment and on the NIWA NZ River Maps[30]. This indicates that there is potential for a progressive reduction in baseflows for Streams 1, 2a and 3 as a result of the proposed quarry expansion.

[29] The WGA Assessment included an assessment for Stream 2. As outlined in Section 6.3.1, residual effects on the downstream remnant of Stream 2 (outside of the quarry expansion footprint) as a result of loss of upstream catchment are considered moderate to very high and will be addressed via freshwater compensation planting as outlined in Section 6.3.4. As such this site is not considered further in this section.

[30] https://shiny.niwa.co.nz/nzrivermaps/. Accessed March 2026.

Table 6.2: Estimated mean annual low flow (MALF) data and predicted reductions in baseflow for Streams 1 to 3

Stream (main channel)	Estimated MALF (NIWA NZ River Maps)	Simulated baseline groundwater contribution (WGA, 2026)	Estimated baseflow reduction – Stage 1 (WGA, 2026)	Estimated baseflow reduction – Stage 5 (WGA, 2026)
Stream 1	3.64 L/s (~315 m^3/day)	6.45 L/s	1.23 L/s (~106 m^3/day)	3.10 L/s (~268 m^3/day)
Stream 2a	(no data available)	0.24 L/s	<0.0001 L/s (<0.009 m^3/day)	0.04 L/s (~3.5 m^3/day)
Stream 3	4.33 L/s (~374 m^3/day)	7.52 L/s	0.01 L/s (~0.864 m^3/day)	1.5 L/s (129.6 m^3/day)

The above figures represent projected changes to stream surface flows for the catchments as a whole, however it is recognised that these changes may vary spatially across a catchment. In order to provide finer spatial resolution for the purposes of this freshwater ecological assessment, WGA further divided stream catchments 1 and 3 into different 'segments' (Figure 6.1). The WGA Assessment notes that due to modelling limitations there is lower confidence in this approach than the whole of catchment scale presented above. Notwithstanding this, the results are presented below and considered useful for the purposes of this ecological assessment.

Results indicated that depletion is not distributed evenly across different parts of the stream catchments. The depletion rates and percent change for each catchment segment is presented in Table 6.3. For completeness, these values are also shown for Streams 2 and 2A, even though these were not divided into further segments.

Stream segments with percentage change considered minor to negligible by WGA in their assessment (2026) were the main northern tributary in the upper reaches of Stream 1 ('Trib 1.2'), Stream 2A ('Trib 2A') and the lower reaches of Stream 3 ('Trib 3.1') (Table 6.3). The remainder of the catchment segments had percent change of greater than 40% by Stage 5.

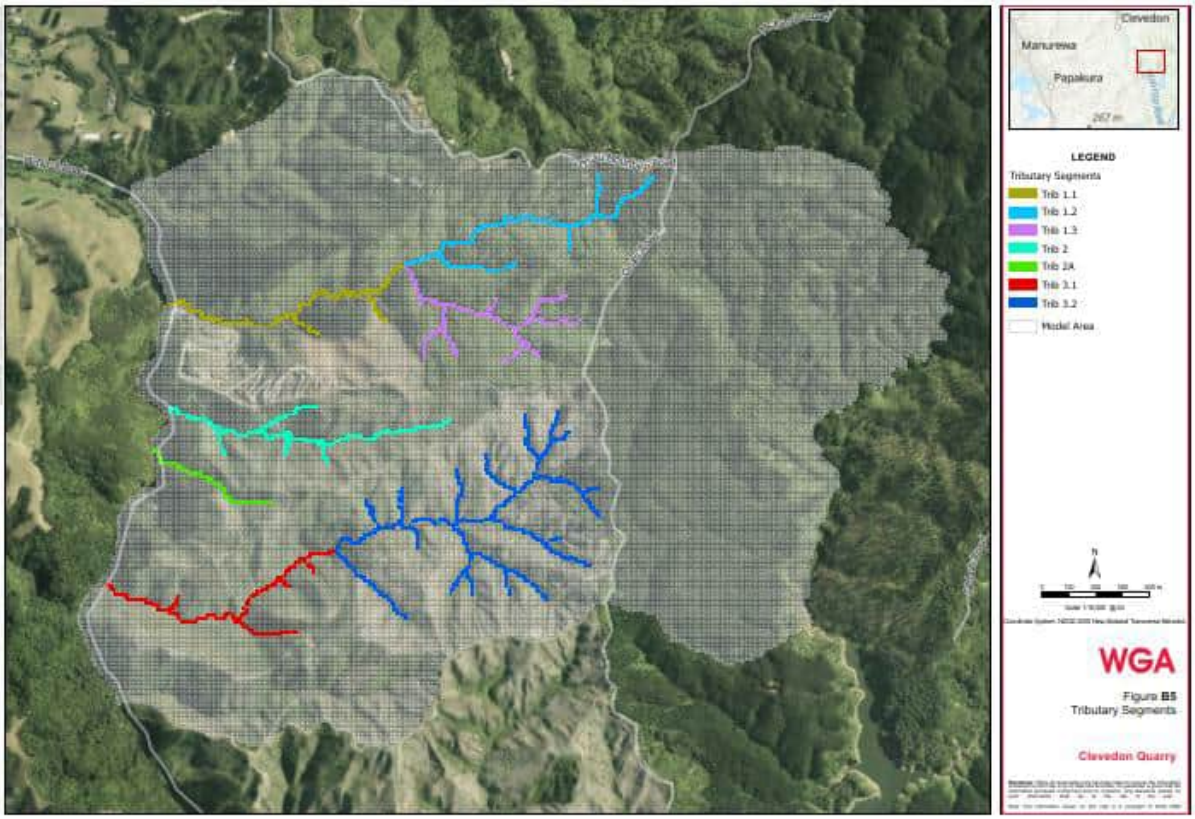


Figure 6.1: Stream catchment 'segments' used for the stream depletion assessment (source: WGA Groundwater Assessment Report, August 2026).

Table 6.3: Stage 5 design groundwater depletion by sub-catchment, with associated magnitudes of effect without management measures

WGA segment name	T+T Stream reach name	Stage 5 Depletion (L/S) (source: WGA, 2026)	Stage 5 Depletion (%) (source: WGA, 2026)	Magnitude of effect without management measures
Trib 1.1	Stream 1 lower reaches	2.31	89.6%	Moderate
Trib 1.2	Stream 1 main northern tributary	0.01	0.2%	Low
Trib 1.3	Stream 1 main southern tributary	0.79	52.7%	Moderate
Trib 2A	Stream 2A	0.04	17.6%	Low
Trib 3.1	Stream 3 lower reaches	0.14	3.3%	Low
Trib 3.2	Stream 3 upper reaches	1.35	40.2%	Moderate

Without mitigation measures in place, where groundwater depletion rates were modelled to be approximately 18% or less[31] (Table 6.3), the magnitude of effects on stream surface flows is expected to be at most **low**.

For the remaining stream segments, depletion of groundwater contribution at Stage 5 ranged from 40.2% to 89.6% (Table 6.3). It is difficult to assess the magnitude of effect on stream flows of groundwater depletion to this extent, and how this may result in an alteration to baseline conditions, as this is likely to vary spatially across the catchment, as well from seasonally and from year to year.

For example, effects are expected to be greatest in summer, when a higher proportion of stream baseflows are groundwater derived, and effects may be less in wetter months due to overland flows. Intermittent tributaries that are located above the regional aquifer represented in the modelling results may continue to receive flows primarily from shallow / perched groundwater, surface runoff, soils and vegetation. Therefore any shift away from existing baseline conditions may be minor. For other streams with greater proportion of groundwater derived baseflow, a more moderate change to existing baseline conditions may result.

Considering the above, it is expected that without mitigation measures in place the magnitude of effects on the streams that had modelled depletion rates of 40.2% to 89.6% could be **moderate** at most.

Proposed management measures for the above effects and the resulting overall levels of effect are discussed in Section 6.3.3.

Effects on other catchments

Groundwater drawdown is expected to divert water away from stream catchments 1, 2, 2a and 3 and into the sump, which is proposed to then be discharged, along with surface flows, to the Wairoa River via the discharge to Stream 1 from the water management system and/or augmentation and to Stream 3 via augmentation. Given the catchment position of the Wairoa River (fifth order stream) and its significantly larger flows compared to Streams 1, 2, 2a and 3, the magnitude of effect on the Wairoa River expected to be **negligible**, as it will likely continue to receive all flows. This results in an overall **low** level of effect to the Wairoa River.

6.3.3 Augmentation Regime Management Plan

An Augmentation Regime Management Plan (ARMP) will be developed and implemented to monitor and manage potential effects on stream flows, which includes augmentation of stream flows where practicable.

Augmentation is proposed to mitigate the potential effects on stream surface flows on the main channels through the Stream 1 and Stream 3 catchments, as well as the Stream 1 main southern tributary. The WGA Assessment (2026) indicated that groundwater inflows to the proposed quarry will be greater than the forecast reductions in baseflow for Streams 1 and 3, indicating a potentially dependable water source for flow augmentation. Proposed stream flow augmentation via either the quarry sump or bores will be undertaken in accordance with the relevant proposed consent conditions and will be designed to maintain baseflows in the aforementioned streams and tributaries. Baseline and ongoing monitoring of baseflows will be used to inform the augmentation regime and the proposed flow regime will be designed to address the predicted loss of flow from dewatering, without over- or under-augmenting affected reaches.

The augmentation point/s will change as the quarry footprint develops and surface flow effects are realised, to ensure that augmentation of stream base flows will occur upstream from where there is

[31] These percent changes were determined by WGA to be negligible to minor.

potential for a decrease in freshwater volume. The ARMP will establish baseline flow conditions and provide a basis against which to measure any change and implement appropriate responses for maintenance of base flows during dry weather conditions (e.g. triggers for augmentation, water quality monitoring and treatment).

With the implementation of augmentation and an ARMP, the magnitude of effect of reduced groundwater contributions on stream surface flows for the Stream 1 main channel, Stream 1 main southern tributary and Stream 3 upper main channel will be reduced to **negligible**, resulting in an anticipated overall **very low** level of effect on these streams.

For the remaining reaches where stream surface flows will potentially be affected by reduced groundwater contribution, and where augmentation is not practicable (Stream 1 tributaries feeding the southern main tributary, and Stream 3 tributaries), the magnitude of effect presented in Table 6.3 above remains relevant. Specifically in respect of Stream 3, it is expected that if effects were to be observed, they would likely be restricted to the northern tributaries as the main channel is a hydraulic boundary and outside of the zone of influence (see Figure 8 of the WGA report). Combined with ecosystem function values, the overall level of effect could be **high** for these tributaries.

6.3.4 Residual effects management

As outlined in Section 6.3.1, there are residual adverse effects on the following:

- stream reaches that will have their upstream catchment areas reduced below 1.4 ha; and
- the downstream remnant reach of Stream 2, which will have up to 92% of its upstream contributing catchment area removed within the quarry footprint.

For these reaches it is assumed that the stream reaches will lose sufficient flow that they will become ephemeral and will no longer support aquatic life. This affects a total of 744 m^2 of streambed area across the four catchments and is proposed to be addressed by freshwater compensation. This will form part of the overall freshwater offsetting and compensation package (refer to Section 6.2.1 and Section 7 for the basis for this approach).

The methodology described in Section 6.2.1 was used to determine a quantum of offset that would be required to address the 744 m^2 of residual adverse effects, should additional offsetting be undertaken offsite (Appendix L – ECR calculations). This was then converted to an area of freshwater compensation planting of 19 ha, to be located within the Stream 3 catchment.

As outlined in Section 6.2.1, a multiplier is considered appropriate to account for the compensation planting being located away from the stream edge (but adjacent to the outer edge of the riparian offset planting margin). If the 19 ha is combined with the 11 ha for residual stream loss effects (30 ha total), the 40.4 ha available in the Stream 3 catchment represents 1.3 times this area. This is considered an appropriate multiplier, and the area of freshwater compensation planting is therefore considered sufficient to address the residual effects on stream surface flows.

There are two additional scenarios where the magnitudes of effect are less certain:

- where a substantial proportion of the catchment area will be removed, but the post-expansion catchment area will be greater than 1.4 ha; and
- where intermittent tributaries of Stream 1 and 3 could be affected by groundwater depletion.

In relation to these two scenarios, and as described in Sections 6.3.1 and 6.3.2, any effects on stream flows are expected to be spatially and temporally variable, reflecting seasonal conditions and/or differences in groundwater connectivity. At most, the magnitude of effect is anticipated to be moderate. The proposed compensation package is considered proportionate to the potential magnitude of effects identified and an appropriate response should residual adverse effects arise.

6.4 Sediment discharge and sediment deposition

Activities associated with the quarry expansion, including vegetation clearance, earthworks, stream removal, overburden disposal area establishment, and ongoing quarry operations, have the potential to increase sediment discharge and deposition within downstream freshwater environments. Headwater stream loss within the Stream 1, Stream 2a, Stream 3 and much of the Stream 2 catchments may increase the potential for sediment transport to downstream reaches. Stream 1 will receive runoff from the operational quarry footprint, with the Wairoa River representing the ultimate receiving environment for all discharges.

Other contaminants that may be present in quarry run-off are expected to be minimal and are therefore not assessed separately. Aany contaminants, if present, will be managed by the Clevedon Quarry Water Management System (WMS) described below and are considered to have effects comparable to those associated with suspended sediment.

Effects of increased suspended and deposited sediment in freshwater ecosystems and on freshwater biota are well documented (see reviews by Cavanagh et al., (2014) and Davies-Colley et al., (2015)). Potential effects include clogging of fish and invertebrate gills, reduced water clarity for visual feeders, disruption to fish passage and upstream migrating fish and smothering of aquatic plants and benthic habitats.

As detailed in the ESC Assessment Report (SouthernSkies, October 2026), ESC measures for the quarry expansion and operation have been designed in accordance with the Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (Leersnyder et al., 2016; 'GD05') and integrated with the staged quarry development approach.

Existing vegetation will be retained where practicable, disturbed areas progressively stabilised, and ESC measures updated as quarry development proceeds.

Runoff from disturbed areas will be managed through the ESC and WMS. Clean water will be diverted around operational areas where practicable, while quarry runoff will be captured within the pit, directed through sediment settlement sumps and discharged via a constructed treatment wetland prior to discharge to Stream 1 upstream of McNicol Road. The upgraded WMS will be commissioned in stages to ensure treatment capacity remains operational throughout construction, with the wetland remaining in place for the life of the quarry.

The Surface Water Management (SWM) Report (Tektus, October 2026) notes that treatment wetland has been designed in accordance with Auckland Council's *Guidance Document 2017/001: Stormwater Management Devices in the Auckland Region* ('GD01') and informed by the Waikato Regional Council's *Waikato stormwater management guideline* (Technical Report TR2020/07). A total suspended solids (TSS) removal target of 90 % has been adopted, exceeding the 80 % TSS removal target specified in GD01 in recognition of the sensitivity of the receiving environment.

Overall, the WMS will provide a higher level of sediment control than conventional GD05 sediment retention devices, by enabling managed treatment and discharge of captured runoff.

Ongoing monitoring will be undertaken to ensure ESC measures remain effective and are adapted to changing catchment conditions throughout the life of the quarry.

Temporary increases in sediment discharge may occur during stream works and overburden disposal area establishment; however, these activities will be undertaken in accordance with GD05 principles and are expected to result primarily in short-term, localised effects.

Without management measures in place and considering the potentially affected streams already have high sediment loads due to forestry activity within the catchment, the magnitude of effects is expected to be **high** at most for ecosystem function values (with reference to the EcIAG assessment

criteria (Appendix C Table 5)). It is expected to be **moderate** for species values as species within the catchment are already subject to high sediment loading due to existing forestry activities.

With the implementation of GD05, mitigation measures including the upgraded WMS, and a monitoring and response framework, the magnitude of effect of sediment discharge and sediment deposition during quarry expansion and operation is assessed to be:

- **Negligible** for the Stream 1 main channel ecosystem function and species values, where flows from the impact area will be treated via the quarry WMS, including the settlement sumps and constructed treatment wetland, prior to discharge to the stream.; and
- **Low** for ecosystem function and **negligible** for species values where potential discharges related to stream works within the impact area (life of quarry boundary and OBDA) will be managed in accordance with GD05 principles. This is the Stream 1 tributaries, Streams 2, 2a and 3 main channel (mid- to upper reaches) and tributaries.

The magnitude of effects is expected to reduce with distance from the discharge point, as any sediment in discharges will settle out and decrease with distance from that discharge point. For these reasons and combined with the proposed ESC management measures described above, the magnitude of effect on the Wairoa River is considered to reduce from **moderate** for ecosystem and species values, down to **negligible** for both values**.**

Depending on the combined level of effect and ecological values, this results in overall **very low** to **low** levels of effect across all sites, for both ecosystem and species values.

6.5 Water quality changes resulting from flow augmentation

As described in Section 6.3.3 above, the upper reaches of the southern tributary of Stream 1 and the upper reaches of the Stream 3 main channel will receive water (likely abstracted from either the quarry sump or bores) to augment baseflows. The lower reaches of the Stream 1 and 3 main channels and the Wairoa River are the ultimate receiving environments for these flows.

There is potential for water quality effects on the receiving environments if water quality parameters, such a water temperature, dissolved oxygen and pH, are very different in the augmentation water compared to that of the streams it is discharged to, and adequate mixing does not occur. Without any management measures in place, for Streams 1 and 3 there is potential for a **moderate** magnitude of effect on ecosystem function values, and **low** for species values as most fauna will be able to move upstream or downstream away from the point of discharge. For the Wairoa River, which is a large waterbody and located further downstream, this is expected to be **low** and **negligible**, respectively.

Water quality of water used for augmentation will be specified and managed via ARMP. The proposed consent conditions will require stream baseline monitoring of water temperature and dissolved oxygen to be undertaken upstream and downstream of the augmentation discharge points. Conditions currently propose that the supplemented flows will be required to not result in, after reasonable mixing, an increase of more than 3°C increase in water temperatures downstream and less than 6 mg/L in dissolved oxygen concentration. This is to mitigate any potential adverse effects on freshwater habitats through a change in water temperature or dissolved oxygen as a result of flow augmentation.

Of the species present within Streams 1 and 3, the species with the lowest preferred temperature (based on Richarson et al., 1994), and therefore considered the most sensitive to temperature increases, is adult banded kōkopu. The exception is the lower Stream 3 catchment, where common smelt, which have a slightly lower preferred temperature, may be present. Preferred temperature ranges (and quartiles) for adult banded kōkopu and common smelt are 17.3°C (16.3°C to 18.3°C) and

16.1°C (15.1°C to 17.4°C), respectively (Richardson et al., 1994). It is noted that the upper lethal temperatures for these species are significantly higher, at 28.5°C and 28.3°C, respectively.

There is no available water temperature monitoring data for Stream 1 and 3. However, median water temperatures between 2021 and 2025 for two Auckland Council monitoring sites within the Wairoa Catchment, Wairoa River and Wairoa Tributary[32], were 16.1°C and 12.5°C, respectively[33]. The 95th percentile values (likely to represent peak-summer temperatures) were 22°C and 16.9°C, respectively[33]. It is acknowledged that the Wairoa River is a much different stream order than Stream 1 and 3; however, does represent an unshaded stream system similar to Stream 3. The Wairoa Tributary is a well-vegetated headwater tributary similar to Stream 1. Therefore, the range of values at these sites is considered to be representative of the potential range of values within Streams 1 and 3, and suggests that most of the time, an increase in temperature of 3°C will be well below the upper lethal temperatures for these species.

Whether or not an increase by 3°C will exceed the preferred temperature ranges for the above species will depend on the actual temperatures of those systems. Ongoing monitoring of water quality, including temperature, is proposed via the development of project-specific monitoring plans. These shall include appropriate responses/actions should exceedances occur, and review of suitability of the 3°C increase in relation to the preferred temperature ranges for the above species.

With respect to dissolved oxygen, according to the NPS-FM attribute band descriptions, 6 mg/L may cause occasional minor stress on sensitive organisms over short periods, and moderate stress over longer periods. Augmentation of flows will be managed by the ARMP, so that it is undertaken only when required, therefore dissolved oxygen values of 6 mg/L downstream of points of augmentation are not likely to occur year-round. Ongoing monitoring of dissolved oxygen is proposed via the development of project specific monitoring plans. These shall include appropriate responses/actions should exceedances occur, and review of suitability of the 6 mg/L increase in relation to the NPS-FM attribute bands.

With the above management measures in place, the magnitude of effects is expected to be reduced to **low** for both ecosystem function and species values, for Streams 1 and 3, and **negligible** for the Wairoa River as it a large river is located downstream of the points of augmentation. Combined with ecological values, for Streams 1 and 3 this results in an overall **low** level of effect on ecosystem function values and a **low** to **moderate** overall level of effect on species values, following the EcIAG framework. The high and very high species values on Streams 1 and 3, respectively, is due to 'At Risk' and ‘Threatened’ species being present. Conservation status of a species does not impact the effectiveness of management measures, therefore the overall level of effect on species values at these sites is considered **'Low'**. For the Wairoa River, the overall level is **very low** for ecosystem function and **low** for species values.

6.6 Scour and erosion effects due to water discharges

The WGA Assessment reports that groundwater inflow to the quarry is predicted to increase to 6.3 L/s at Stage 5 for the proposed expansion (compared to approximately 1.7 - 2.8 L/s for the 2018 consented design), reflecting the larger excavation footprint and increased interception of groundwater flow. These flows will be discharged to Stream 1 via the water management system (WMS), along with runoff from the quarry. Additionally, as the quarry expansion progresses, flows from Stream 2, which currently discharge directly to the Wairoa River, will also be diverted to Stream 1 via the constructed wetland system. Intercepted groundwater flows may also be used for

[32] An upper-catchment stream within native forest, in the upper reaches of the Wairoa River Catchment and south of the site.
[33] Auckland Council Environmental Data Portal, https://environmentauckland.org.nz/Data/, accessed on 15 September 2026.

augmentation of flows with discharge points in the upper reaches of Streams 1 (main channel and the main southern tributary) and Stream 3.

Without adequate management measures, there is potential for these discharges to these streams, and ultimately the Wairoa River, to cause stream channel erosion, increasing sediment loads and altering channel morphology. Stream substrates within Streams 1 and 3 are generally of a hard-bottomed nature, meaning they are less susceptible to scour and erosion at discharge points compared to soft-bottom streams. Additionally, some intercepted flows may be used for augmentation as mentioned above, therefore not all flows will be directed to one discharge point but will be distributed amongst several points. An ARMP will be developed and implemented to monitor and manage augmented flows, including monitoring of discharge points for erosion and scour effects.

As also outlined above, flows from across the site to be discharged to Stream 1 will be directed to a sump which will provide storage to attenuate flows before water is conveyed in a controlled manner to a constructed wetland near the site entrance. The SWM Report details that the sump and constructed wetland are proposed to attenuate peak flows for storm events up to and including the 100-year ARI (including climate change allowances), and to manage peak flows so that post-development runoff does not increase flood risk.

As described above, Stream 1 will be the receiving environment for runoff from the quarry, intercepted groundwater and diverted Stream 2 flows, via the quarry WMS. The upper reaches of Stream 1 and 3 will receive augmented flows. The Wairoa River will be the ultimate receiving environment for these flows.

Without management measures in place, the magnitude of effects on the receiving environments is expected to be **moderate** to **high**, decreasing with distance from the discharge point.

The implementation of the above proposed management and mitigation measures will reduce the magnitude of effect to **negligible** on all of the above stream reaches, which results in an overall effect of **very low** for all potentially affected streams.

6.7 Summary of freshwater effects

Freshwater ecological values recorded at the site range from very low to very high. Implementation of best practice measures to manage effects means that for the most part, effects can be reduced to a very low to low level. Residual effects addressed through offsetting and compensation and all adverse freshwater ecological effects of the project can be appropriately managed. Table 6.4 presents a summary of the freshwater ecological values and effects described in Sections 4.2 and 6. Further discussion of the approach to residual effects management is provided in Section 7.

Table 6.4: Summary of freshwater ecological values and effects of the Clevedon Quarry expansion, with proposed approaches to residual effects management

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
Injury and mortality of freshwater fauna	Stream 1 tributaries (excluding main southern tributary)	High (species)	Moderate (catchment scale)	Implementation of a FMP which outlines management measures including undertaking instream works in summer where practicable, and including capture and relocation where site access is possible to minimise as much as practicable injury and mortality effects on native freshwater fauna.	Low	-
	Stream 2	High (species)	High (catchment scale)		High	High species value due to 'At Risk' species being present. Conservation status of a species does not impact the effectiveness of management measures, therefore the overall level of effect is considered 'Low'.
	Stream 2a	Low (species)	Moderate (catchment scale)		Very Low	-
	Stream 3 tributaries including	High to very high (species)			Moderate	Very high species value due to potential for Regionally 'Threatened' kōaro to be

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
	overburden disposal site		Moderate (catchment scale)			present. Conservation status of a species does not impact the effectiveness of management measures, therefore the overall level of effect is considered 'Low'.
Permanent loss and modification of stream habitat.	Stream 1 tributaries (including main southern tributary)	High (ecological function) (Potential: High to Very High)	Very High	There will be loss of intermittent and permanent stream within the quarry expansion footprint and OBDA that cannot be further avoided, remedied or minimised.	Very High	Freshwater offset and compensation actions to provide freshwater ecological benefits within the Stream 3 catchment.
	Stream 2 and Stream 2a	Moderate to High (ecological function)	Very High		High to Very High	
	Stream 3 tributaries including overburden disposal site, excluding bush covenant area	Moderate (ecological function)	Very High		High	

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
Changes to surface stream flows – upstream catchment area reduced to less than 1.4 ha (shift to ephemeral flows)	Stream 1 tributaries (including main southern tributary)	High (ecological function)	High	Upstream catchment area will be removed within quarry expansion footprint and OBDA, and augmentation of headwater tributaries not practicable. Effect cannot be further avoided, remedied or minimised.	Very High	Freshwater compensation actions to provide freshwater ecological benefits within the Stream 3 catchment.
	Stream 2 and 2a	Moderate to High (ecological function)	High		Moderate to Very High	
	Stream 3 tributaries including overburden disposal site, excluding bush covenant area	Moderate (ecological function)	High		Moderate	
Changes to surface stream flows – upstream catchment area remains greater than 1.4 ha but	Stream 1 main channel	High (ecological function)	Moderate	Augmentation of stream flows on Stream 1 main channel and main southern tributary, Stream 3 main channel (managed through ARMP).	Very Low	For intermittent streams, freshwater compensation actions to provide freshwater ecological benefits within the Stream 3 catchment.
	Stream 1 tributaries (including main southern tributary)	High (ecological function)	Moderate		Very Low (main southern tributary)	

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
significantly reduced area					Moderate (other tributaries)	
	Stream 2a	Moderate to High (ecological function)	Moderate		Moderate	
	Stream 3 main channel	Moderate to High (ecological function)	Moderate		Very Low	
	Stream 3 tributaries including overburden disposal site	Moderate* (ecological function) *High-value tributaries within the covenant bush area not included here, as these will not be affected.	Moderate		Moderate	
Changes to surface stream flows – reduced groundwater contributions	Stream 1 main channel	High (ecological function)	Moderate	Augmentation of stream flows on Stream 1 main channel and main southern tributary, Stream 3 main channel (managed through ARMP).	Very Low	For intermittent tributaries, freshwater compensation actions to provide freshwater ecological benefits within the Stream 3 catchment.

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
	Stream 1 tributaries (including main northern and main southern tributary)	High (ecological function)	Low (main northern tributary) Moderate (main southern tributary & associated tributaries)		Low (main northern tributary)	
					Very Low (main southern tributary to be augmented)	
					High (tributaries feeding the main southern tributary)	
	Stream 2a	Moderate to High (ecological function)	Low		Low	
	Stream 3 main channel	Moderate to High (ecological function)	Low (lower reaches) Moderate (upper reaches)		Very Low	
	Stream 3 tributaries including	Moderate to High* (ecological function)	Moderate		High	

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
	overburden disposal site	*High-value tributaries within the bush covenant area				
	Wairoa River mid-catchment, downstream of the proposed impact site	Moderate (ecological function)	Negligible		Very Low	
Sediment discharge and deposition	Stream 1 main channel	High (ecological function); Very high (species)	High (ecosystem function) Moderate (species)	Implementation of best practice erosion and sediment controls (ESCs) across the site and Water Management System including constructed treatment wetland to reduce risk of sedimentation during the expansion and operation of the quarry and discharge of quarry runoff.	Very Low (ecosystem function) Low (species)	-
	Stream 1 tributaries (including main southern tributary)	High (ecological function); High (species)			Low (ecosystem function) Very Low (species)	-
	Stream 2 and 2a	Moderate to High (ecological function); High (species)			Low (ecosystem function) Very Low (species)	-

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
	Stream 3 main channel	Moderate to High (ecological function); High to Very High (species)			Low (ecosystem function) Very Low to low (species)	-
	Stream 3 tributaries including overburden disposal site, excluding bush covenant area	Moderate (ecological function); High to Very High (species)			Low (ecosystem function) Very Low to low (species)	-
	Wairoa River mid-catchment, downstream of the proposed impact site	Moderate (ecological function); Very high (species)	Moderate		Very Low (ecosystem function) Low (species)	-
Water quality effects from the discharge of abstracted groundwater	Stream 1 main channel	High (ecological function); Very high (species)	Moderate (ecosystem function) Low (species)	ARMP to specify and manage water quality of water used for augmentation.	Low (ecosystem function) Moderate (species)	High species value due to 'At Risk' species being present. Conservation status of a species does not impact the effectiveness of management measures, therefore the overall level of effect is considered 'Low'.

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
	Stream 1 tributaries (main southern tributary)	High (ecological function); High (species)			Low (ecosystem function) Low (species)	-
	Stream 3 main channel	Moderate to High (ecological function); High to Very High (species)			Low (ecosystem function) Low to Moderate (species)	Very high species value due to potential for Regionally 'Threatened' kōaro to be present. Conservation status of a species does not impact the effectiveness of management measures, therefore the overall level of effect is considered 'Low'.
	Wairoa River mid-catchment, downstream of the proposed impact site	Moderate (ecological function); Very high (species)	Low (ecosystem function) Negligible (species)		Very Low (ecosystem function) Low (species)	-
Discharge of quarry runoff and augmented flows - potential for stream channel scour and erosion.	Stream 1 main channel & main southern tributary	High (ecological function)	Moderate to High	Discharges to be managed via the quarry water management system and ARMP.	Very Low	-
	Stream 3 main channel	Moderate to High (ecological function)	Moderate to High		Very Low	-

Effect	Stream	Ecological value	Magnitude of effect (unmitigated)	Proposed effects management (avoid, remedy, minimise)	Overall level of effect (mitigated)	Proposed approach to residual effects management
	Wairoa River mid-catchment, downstream of the proposed impact site	Moderate (ecological function)	Moderate		Very Low	-

7 Residual effects management

7.1 Residual effects management approach

As discussed above, it is not possible to avoid, minimise, or remedy all adverse ecological effects associated with the loss of native terrestrial vegetation and loss of stream extent. Residual ecological effects will be addressed through restoration planting in the Stream 3 catchment immediately to the south of the quarry footprint. The target ecosystem is WF9 (taraire, tawa, podocarp forest), which is the forest type present in the protected native forest remnant.

Restoration of the Stream 3 catchment was considered as the preferred option to address the residual ecological effects for several reasons. The Stream 3 catchment is considered most appropriate for this work because it is the closest catchment to the point of impact for both terrestrial and freshwater effects. It is representative of similar stream types to those being impacted and has similar freshwater fauna communities. Similarly, the topography and soil types are similar to the terrestrial habitats being impacted. The Stream 3 catchment also contains a mature native forest remnant and an area of native treeland, and restoration planting will provide connectivity and buffering to these habitats. These areas of mature vegetation will provide an important seed source to enhance the diversity of plantings through natural processes. The overall goal of the restoration is to provide a fully forested corridor linking the Wairoa River to the Hunua Ranges and connecting the existing vegetation fragments contributes to this goal. All planting areas and the existing native treeland will be legally protected in perpetuity.

The Stream 3 catchment contains 4,510 m of intermittent and permanent stream that is considered suitable for offsetting residual effects on streams. Riparian planting of the margins of these streams to 20 m (on each bank) will improve shading and stream temperature control, slow runoff, stabilise banks and reduce sediment inputs to the stream channels. SEV/ECR calculations indicate that this riparian offset planting will address 38% (by streambed area) of these residual effects on streams (refer to Section 6.2.1).

Freshwater compensation planting has been proposed within the Stream 3 catchment to address the remaining 62% of unavoidable residual freshwater effects. In addition to being close to the impact site, the Stream 3 catchment is considered the most ecologically beneficial location for freshwater compensation planting because the benefits of the planting will contribute directly to the improved ecological condition of the streams within the catchment, and further downstream to the Wairoa River. Locating the compensation planting adjacent to riparian offset planting will enhance and maximise the aquatic ecology benefits that will be provided by the 20 m riparian planting outlined above. Retiring the upper catchment from forestry will substantially reduce fluxes of fine sediment that are currently released to the streams within the catchment each felling cycle. The steep slopes will be stabilised by the restoration planting, further reducing sediment loads to the streams.

Overall, providing all offset and compensation planting in a single catchment immediately adjacent to the impact site will provide the following benefits:

- A forested corridor linking the Wairoa River to the Hunua Ranges.
- Minimal edge effects leading to a well-buffered core as the plantings establish.
- Formation of a functioning ecosystem across 51.1 ha.
- Once planting mature, provision of habitat for ‘At Risk’ and ‘Threatened’ fauna and flora known to be present in the wider quarry landholdings including Hochstetter’s frog, long-tailed bats, and king fern.
- Reduced risk of future disturbance on planting areas in the upper catchment caused by other land uses such as farming or forestry.

- Stabilising of steep slopes to minimise slips and erosion.
- Minimising sediment input into watercourses and the receiving environment.

As discussed in Section 2.4, local iwi are supportive of offset and compensation actions being undertaken in the Stream 3 catchment. It is understood that provision of a corridor linking the Wairoa River to the Hunua Ranges is also supported by iwi.

This approach is consistent with the offset and compensation principles outlined in the NPS-IB and NPS-FM. A full assessment against these principles is provided in Appendix N.

7.2 Restoration planting

Restoration planting within the Stream 3 catchment will comprise:

- Planting of steep slopes in the upper catchment of Stream 3 as terrestrial offset and freshwater compensation (Section 7.2.1).
- Planting of the OBDA once it is full as terrestrial offset (Section 7.2.1).
- Planting the 20 m riparian margins of Stream 3 and upper catchment tributaries of Stream 3 as freshwater offset (Section 7.2.2).
- Planting of an additional 20 m either side of the main stem of Stream 3 downstream of the existing native treeland as freshwater compensation (Section 7.2.1).

Table 7.1 summarises residual effects management measures in relation to the effects being addressed.

Table 7.1: Summary of residual effects management measures

Impact	Residual effects management	
	Slope planting /additional riparian buffer (ha)	20 m riparian buffer planting (ha)
Terrestrial habitat loss offset	10.6	n/a
Freshwater habitat loss offset	n/a	16.6
Freshwater habitat loss compensation	40.4	n/a
Total package		67.6 ha

7.2.1 Slope, OBDA, and extended riparian buffer planting

Slopes within the Stream 3 catchment, the OBDA, and an additional 20 m buffer either side of Stream 3 riparian planting downstream of the existing native vegetation will be planted to offset terrestrial residual effects and compensate freshwater residual effects. As discussed in Section 5.1.1.2, the loss of 6.1 ha of terrestrial vegetation and fauna habitat will be offset with 10.6 ha of restoration planting. An additional 40.4 ha of planting will be undertaken to compensate for the loss of 1,158 m^2 of streambed area that is not able to be offset through riparian planting (see Section 7.2.2). Restoration planting areas are shown in Appendix A Figure 8.

All pest plant species will be controlled prior to planting to give native species the best chance of establishment. The planting areas currently contain large quantities of pine slash following felling, which will be left in situ to provide shelter for establishing plants and to provide fauna habitat.

Initial planting will comprise a standard revegetation species recommended for planting in open areas in Auckland (Auckland Council 2023). These species are hardy and are known to establish readily in open areas. It is likely that several planting mixes will be developed based on site

characteristics such as soil moisture, elevation, and aspect. Enrichment planting will be undertaken several years after initial planting to add species characteristic of the WF9 ecosystem to the planting areas. Again, the species mixes selected for enrichment planting will be modified to suit site characteristics. It is anticipated that natural regeneration will occur as plantings establish as seeds from existing mature native trees arrive in the planting areas.

Pest plant control will be undertaken on an ongoing basis as plantings become established. The frequency of pest plant control will decrease as plantings become established and after 5 years control will likely only be required along forest edges.

Pest animal control was not included as an offset action in the BOAM calculations and pest animal control will be limited to control of species that are having an adverse effect on plant establishment.

7.2.2 Riparian planting

The loss of streams will be compensated for with the provision of riparian planting in a 20 m buffer along both sides of 4,510 m (4,420 m^2 streambed area) of the Stream 3 main channel and its permanent and intermittent tributaries.

All pest plants will be controlled prior to planting being undertaken and ongoing control will be provided as plants become established.

The plant mix for riparian areas will comprise hardy species that are known to establish well on bare stream banks in the Auckland region (Auckland Council 2023). Enrichment planting is not considered necessary due to the proximity of the riparian planting areas to existing seed sources. As with restoration planting, pest animal control will be limited to control of species that are having an adverse effect on plant establishment.

7.3 Monitoring and additional management measures

Regular monitoring is recommended to ensure the success of restoration and riparian planting. During the planting establishment phase (generally 5 years after planting), plantings will be monitored regularly to assess survivorship and pest plant/animal control requirements. Once the plants are well established the focus of monitoring will be to track the progress of the plantings against the targets set in the BOAM calculations. This monitoring will be undertaken using modified RECCE plots which will be established within 12 months after planting. The plots will be re-surveyed at Year 25 and assessed against the BOAM targets.

Similarly, monitoring will be undertaken at Year 20 to assess whether the stream subject to riparian planting have met the targets set in the SEV/ECR calculations.

7.4 Summary of residual effects management

Residual ecological effects that cannot be avoided, minimised, or remedied will be addressed through restoration planting within the Stream 3 catchment, immediately south of the quarry footprint. The target ecosystem is WF9 (taraire, tawa, podocarp forest). This catchment is considered the most appropriate location because it is close to the impact site, contains comparable terrestrial and freshwater habitats, and includes existing mature native forest and treeland that can provide seed sources for future natural regeneration. The restoration will create a forested corridor linking the Wairoa River with the Hunua Ranges, while also stabilising steep slopes, reducing erosion and sediment inputs, improving stream shading and temperature control, and providing habitat for a range of native fauna. All planting areas and existing native treeland will be legally protected in perpetuity.

Restoration will include approximately 10.6 ha of slope and open-area planting to offset terrestrial residual effects. Riparian planting within the 20 m margins on both sides of approximately 4,510 m

of permanent and intermittent streams will be undertaken (approximately 16.6 ha of riparian planting). This riparian offset planting will address approximately 38% of the residual freshwater effects, with a further 40.4 ha of freshwater compensation planting addressing the remaining effects through catchment restoration and retirement from forestry. The total offset and compensation package will provide 67.6 ha of new plantings within the Stream 3 catchment. therefore 67.6 ha of planting within the Stream 3 catchment. Pest plant control will be undertaken before planting and during establishment, with planting mixes selected to suit local site conditions and enrichment planting undertaken where required to support development toward the WF9 target ecosystem. Planting success will be monitored and assessment against the BOAM and SEV/ECR targets established through the biodiversity offset and accounting calculations.

Full details of restoration planting methods, monitoring, and ongoing management will be provided in the Ecological Management Plan (EMP), attached to the substantive application.

8 Summary and conclusion

A combination of desktop review and comprehensive field investigations was undertaken to assess ecological values across the site and to provide the information required for an ecological impact assessment. Field assessments were completed across 27 site visits between March 2025 and August 2026 by experienced ecologists. Effects were assessed using the EIANZ EcIAG, with freshwater residual effects quantified using the SEV/ECR methodology and terrestrial residual effects quantified using the BOAM.

Terrestrial ecological values (both vegetation/habitat types and species) range from negligible to very high. Species of note include long-tailed bat, Hochstetter's frogs, and king fern. Freshwater values (both function and species) range from low to very high. Freshwater species of note include longfin eel, torrentfish, inanga and kōaro.

The potential adverse effects on terrestrial habitats and fauna have been identified as: permanent loss of vegetation, edge effects on native vegetation outside of the quarry footprint, loss of 'At Risk-Declining' king fern, injury or mortality of native fauna, and disturbance of native fauna. Most adverse effects can be reduced to an overall level of effect of very low or low through implementation of standard management measures. The overall level of effect of the loss of high value forest is high and residual effects management is required.

The potential adverse effects on freshwater habitats and fauna include loss of stream habitat through stream reclamation, injury or mortality of native fauna, changes in stream flows, sediment discharge and deposition, and stream channel scour/erosion. The overall level of effect can be reduced to very low or low through implementation of standard management measures; however, residual effects of stream reclamation or changes in stream flows remain.

Residual effects on terrestrial and freshwater habitats will be addressed through restoration planting within the Stream 3 catchment, immediately south of the quarry footprint. The overall goal of the restoration is to provide a fully forested corridor linking the Wairoa River to the Hunua Ranges and this catchment is considered the most appropriate location because it is close to the impact site, contains comparable terrestrial and freshwater habitats, and includes existing mature native forest and treeland that can provide seed sources for future natural regeneration. For terrestrial, 10.6 ha of restoration planting is proposed to offset the loss of 6.1 ha of regenerating tree fern/broadleaf forest. Riparian planting within 20 m wide margins on both banks of permanent and intermittent streams within the Stream 3 catchment (approximately 16.6 ha) is proposed as the primary freshwater offset. A further 40.4 ha of planting is proposed to compensate residual freshwater effects.

The total restoration package of 67.6 ha of restoration planting will establish a 'river to ridge' corridor providing potential future habitat for freshwater fauna, long-tailed bats, native birds, Hochstetter's frog, and king fern. All planting will be monitored for a minimum five-year establishment phase under an Ecological Management Plan (EMP) submitted with the substantive application, with assessment against the BOAM and SEV targets at year 25 and 20 respectively. The residual effects management package is proportionate to the scale and nature of the ecological impacts and is consistent with mana whenua preferences for a native vegetated corridor linking the Wairoa River and the Hunua Ranges.

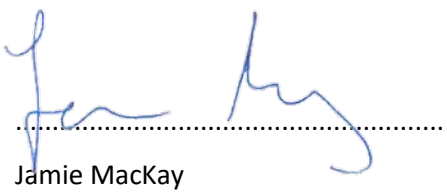
9 Applicability

This report has been prepared for the exclusive use of our client Stevenson Aggregates Ltd. , with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application under the Fast-track Approvals Act 2024 and the appointed panel will use this report for the purpose of assessing that application.

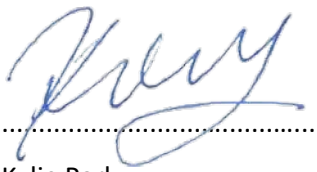
Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:



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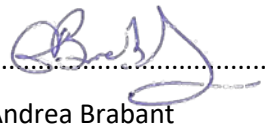
Jamie MacKay
Senior Ecologist



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Kylie Park
Aquatic Ecologist

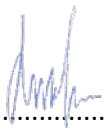
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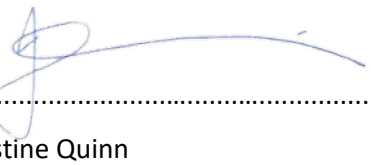
Andrea Brabant
Project Director

Reviewed by



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Josh Markham
Principal Ecologist



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Justine Quinn
Technical Director Freshwater Science & Ecology

JAWM

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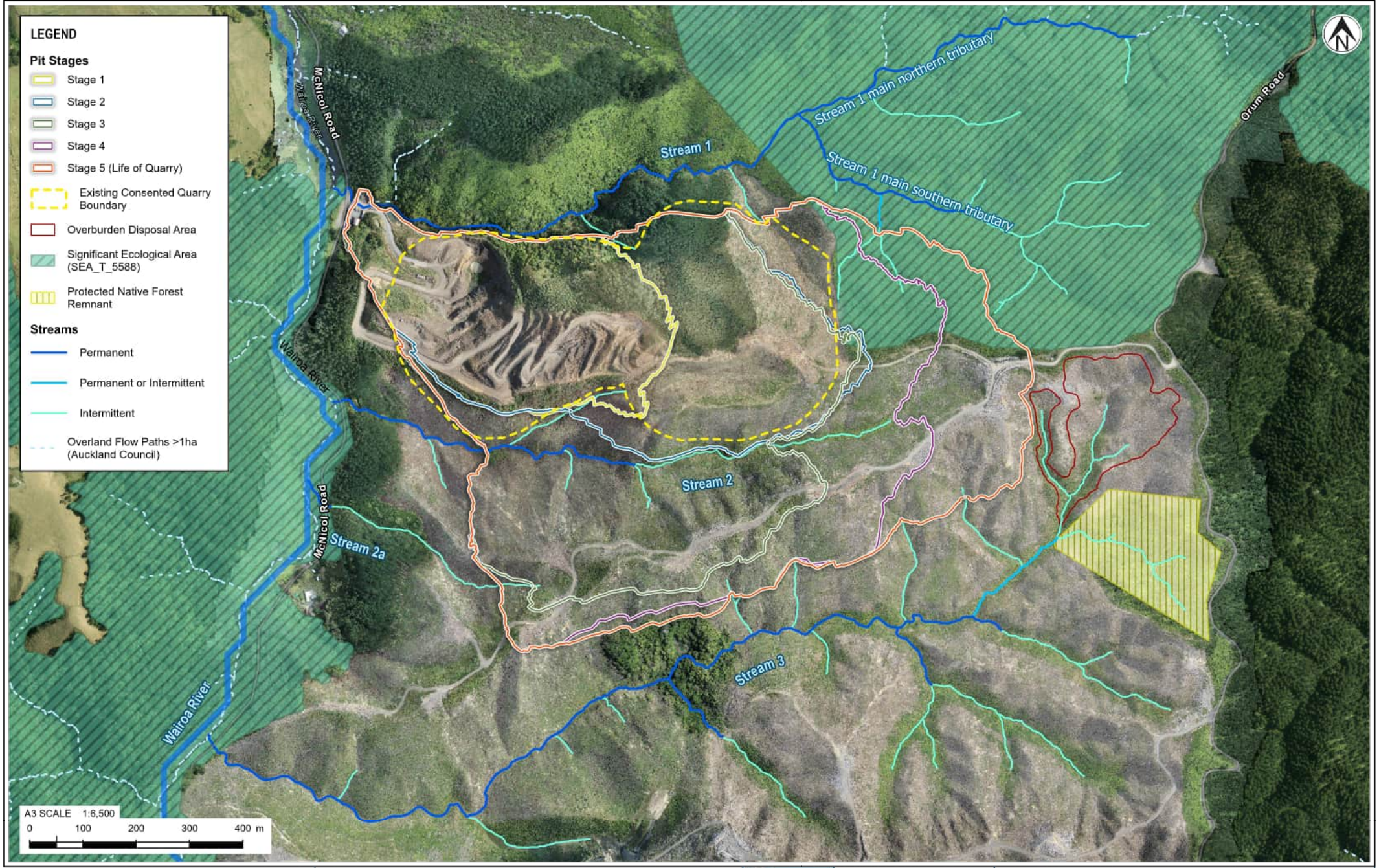
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Appendix A Figures

- **Appendix A Figure 1 - Project overview and features mentioned in text**
- **Appendix A Figure 2 - Terrestrial survey locations**
- **Appendix A Figure 3 - Freshwater survey locations**
- **Appendix A Figure 4 - Terrestrial vegetation types**
- **Appendix A Figure 5 - Potential frog habitat**
- **Appendix A Figure 6 - Bat survey results**
- **Appendix A Figure 7 - Freshwater ecological effects – reaches assessed**
- **Appendix A Figure 8 - Residual effects management**

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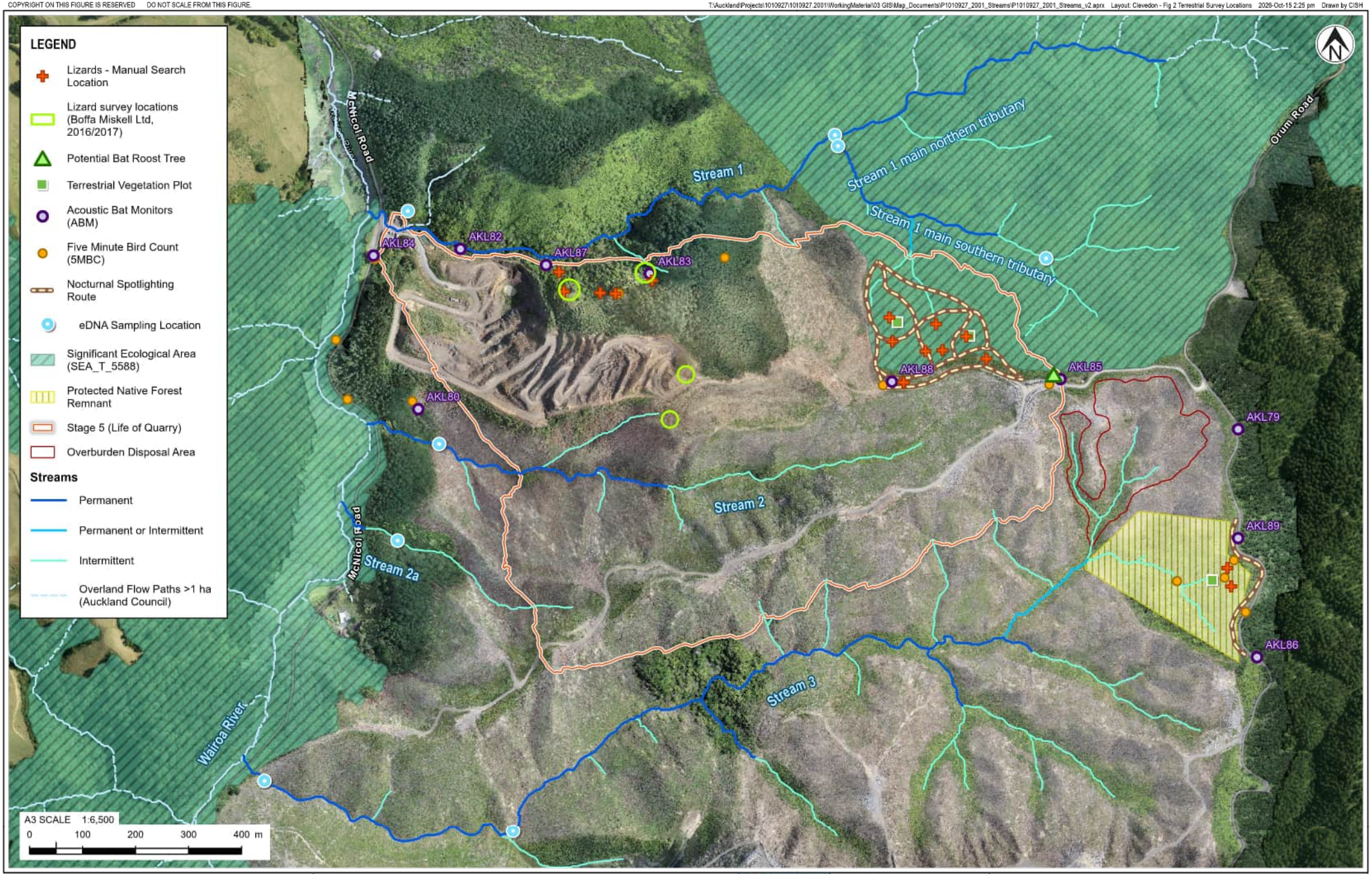
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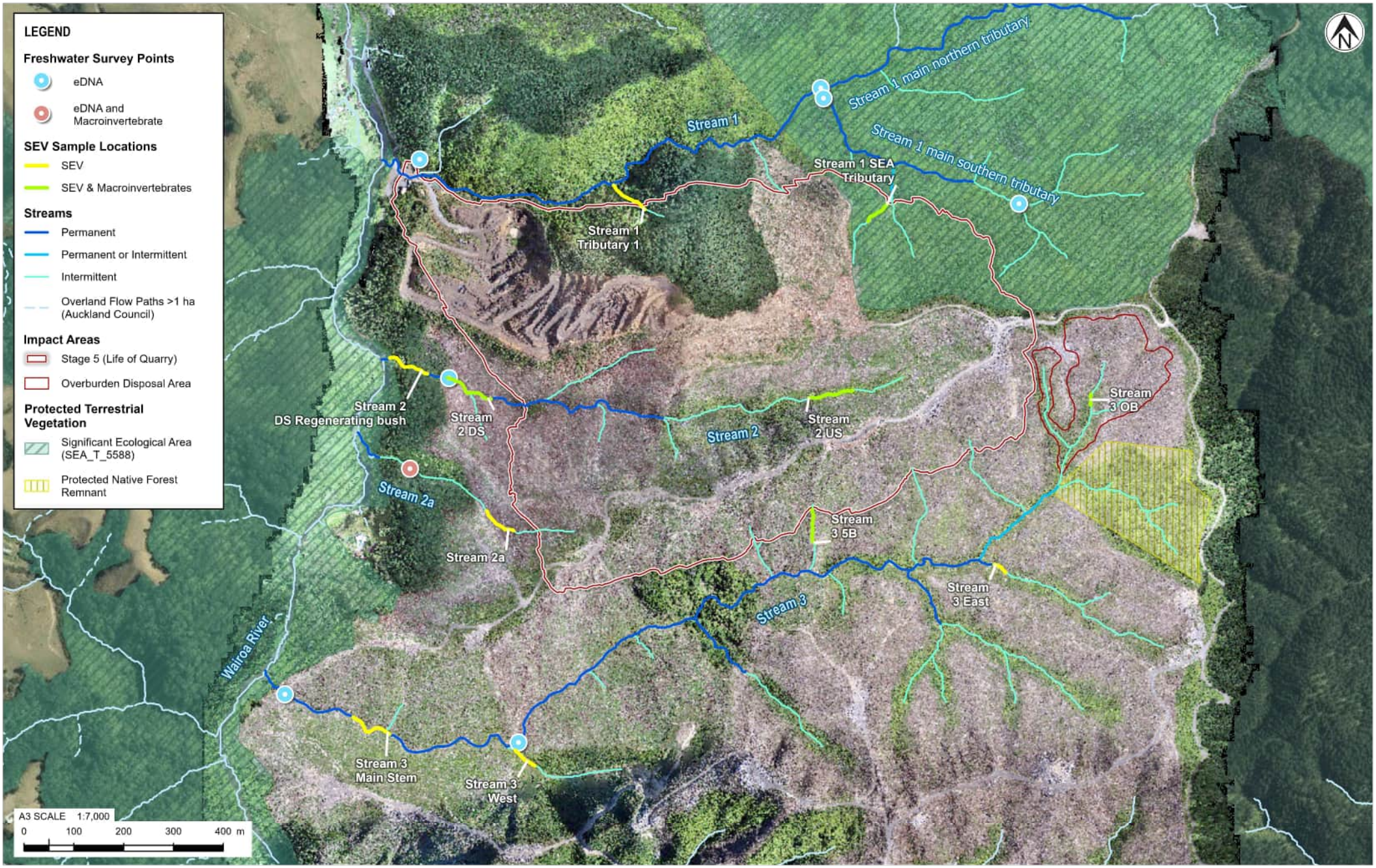
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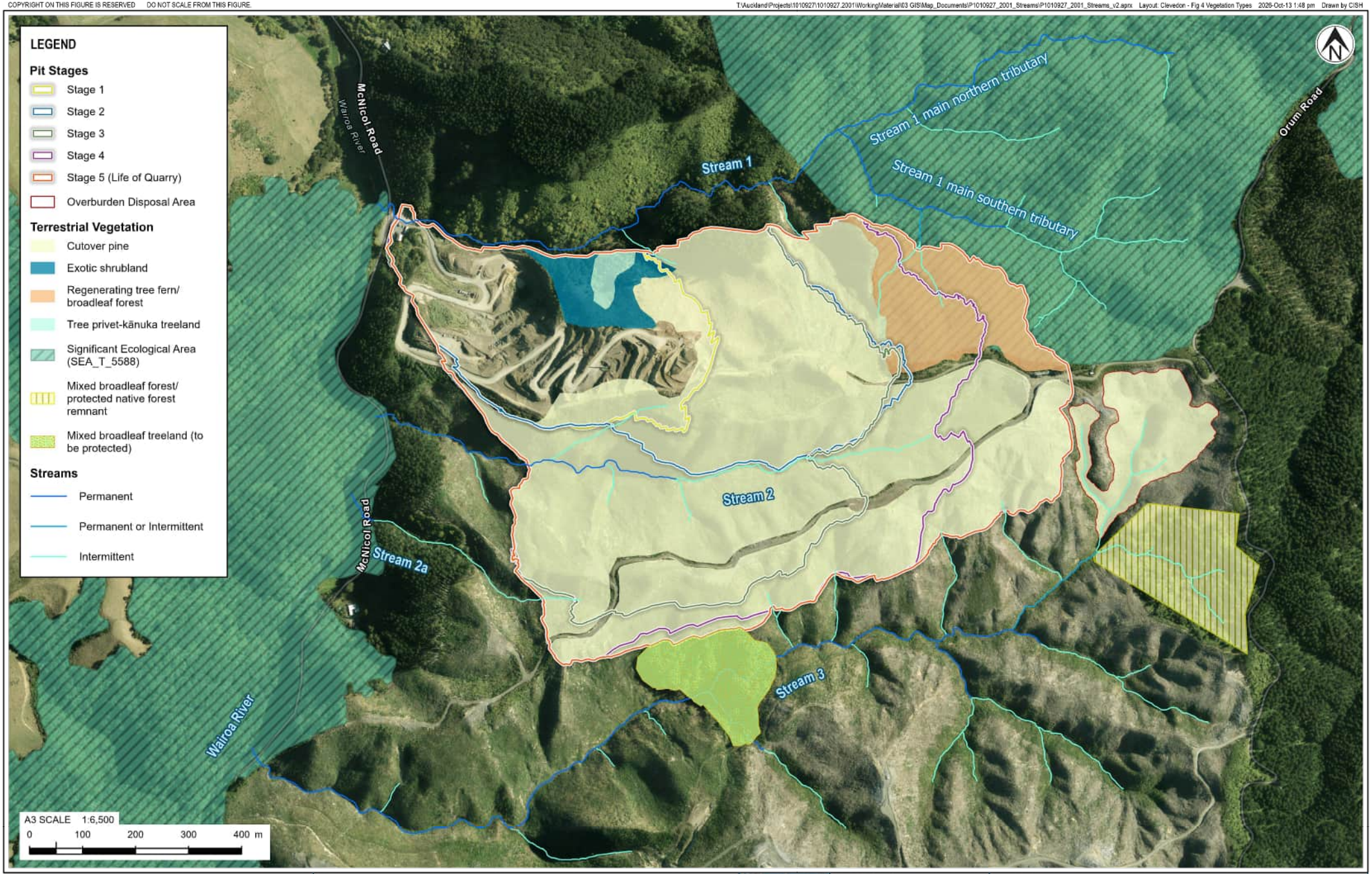
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TITLE FRESHWATER SURVEY LOCATIONS

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TITLE TERRESTRIAL VEGETATION TYPES

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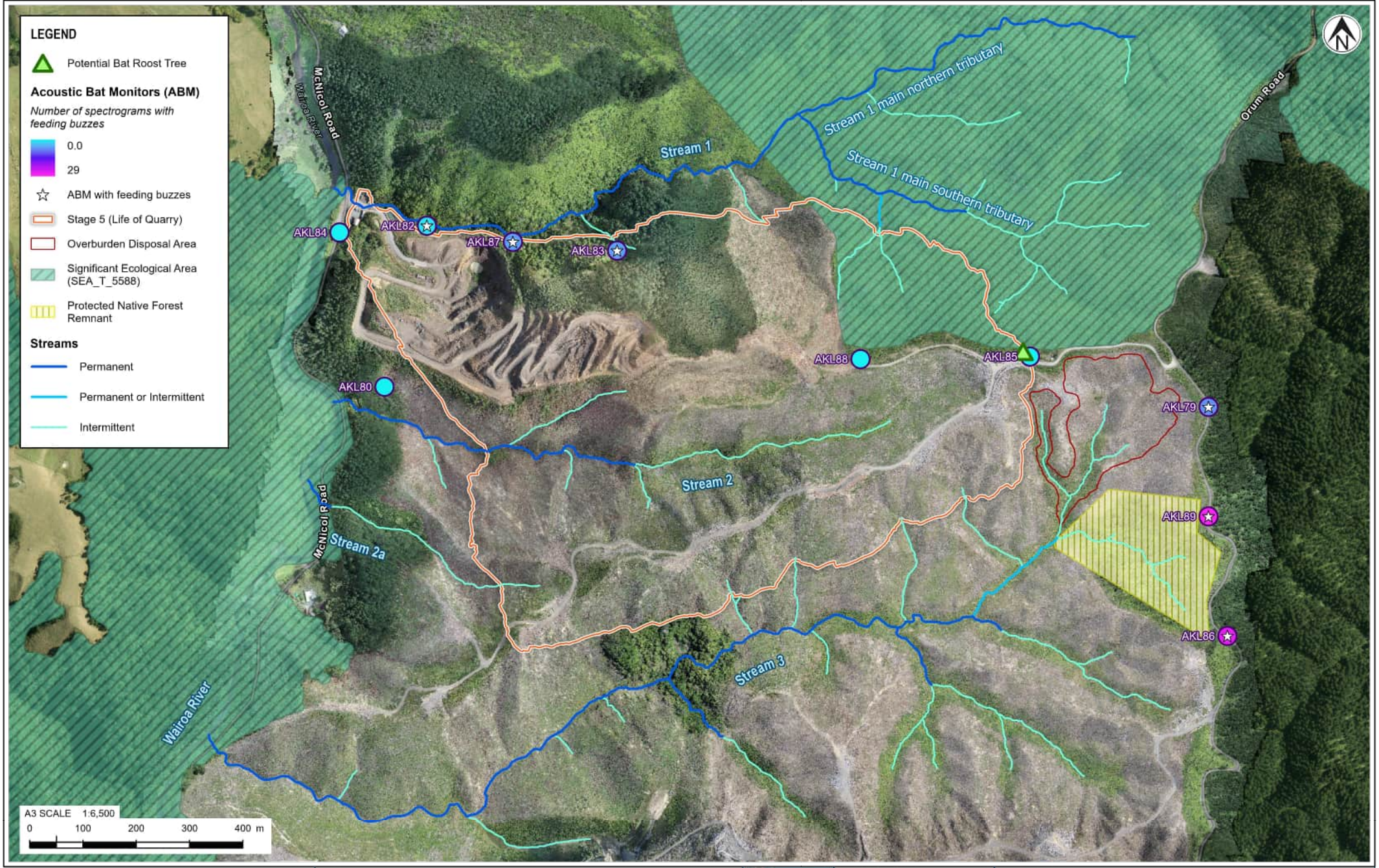
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TITLE POTENTIAL FROG HABITAT

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REV	DESCRIPTION	GIS	CHK	DATE
0	First version	JORB	DSMI	24/06/26
1	Second version	CISH	JORB	15/10/26



LOCATION PLAN

PROJECT No.	1010927.2001		
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DRAWN	CISH	OCT.26	DATE
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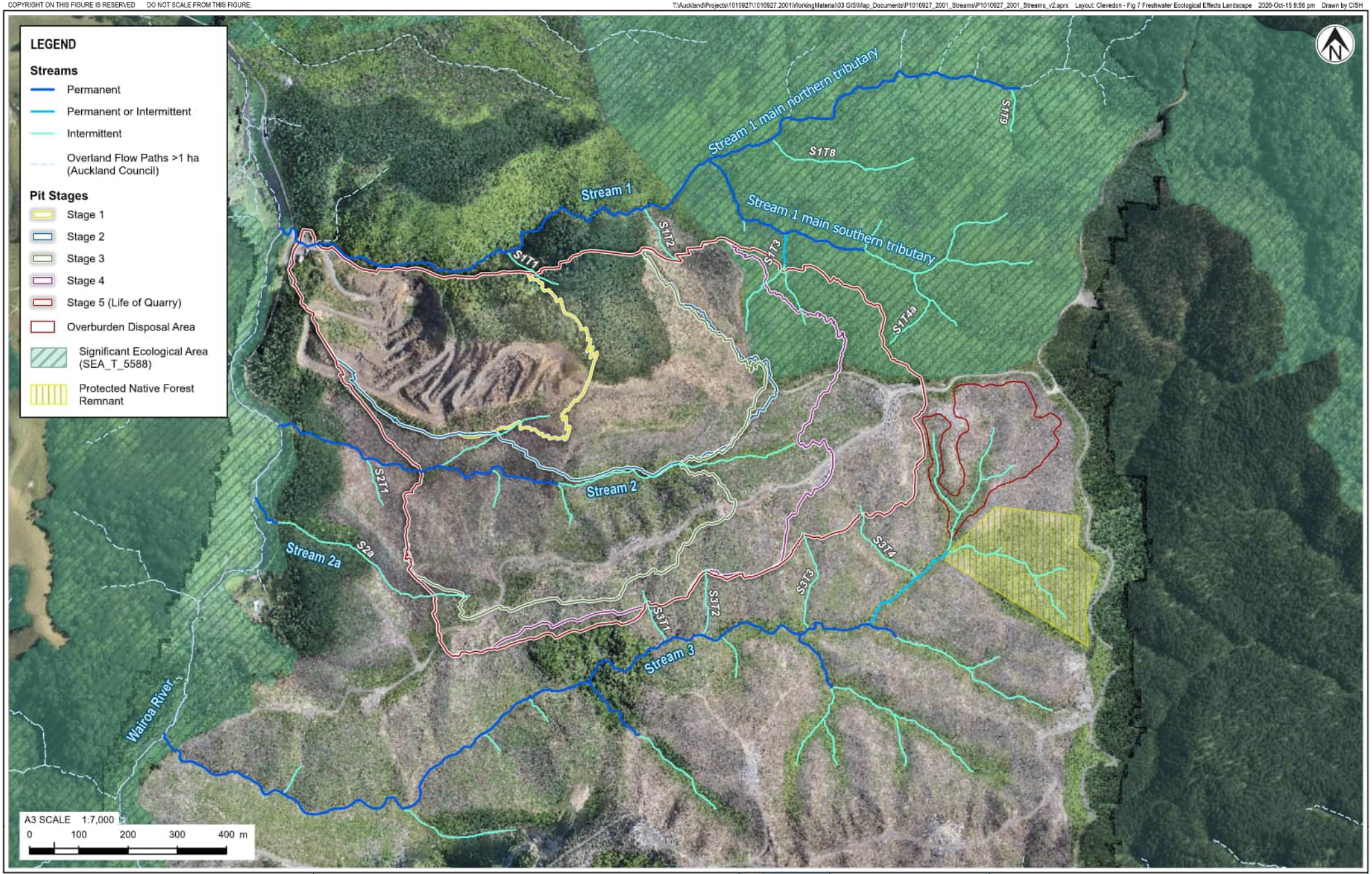
PROJECT **CLEVEDON QUARRY - ECOLOGY**

TITLE BAT SURVEY RESULTS

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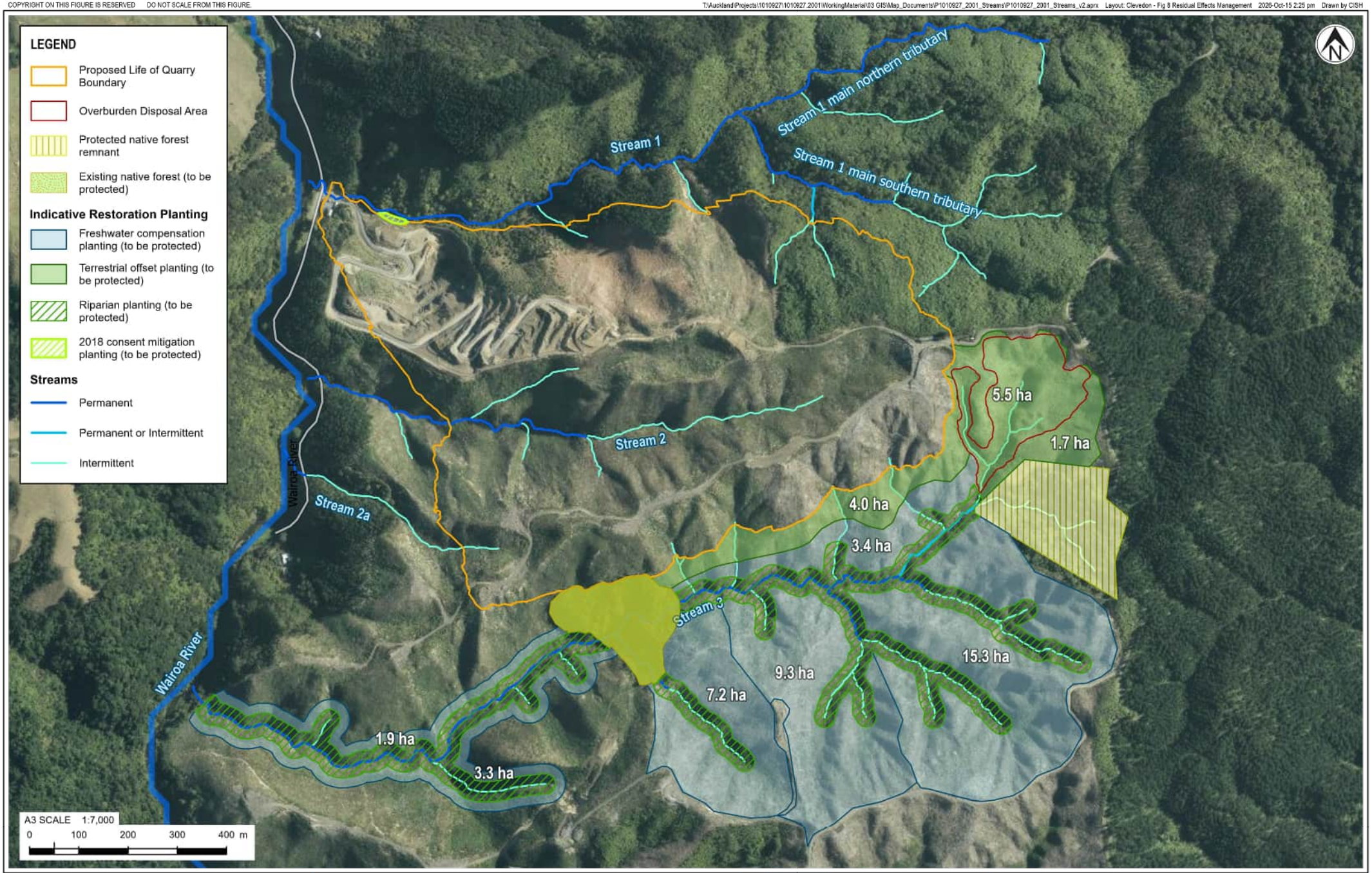
PROJECT **CLEVEDON QUARRY - ECOLOGY**

TITLE FRESHWATER ECOLOGICAL EFFECTS - REACHES ASSESSED

SCALE (A3) 1:7,000 FIG No. FIGURE 7 REV 1

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LOCATION PLAN

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PROJECT **CLEVEDON QUARRY - ECOLOGY**

TITLE RESIDUAL EFFECTS MANAGEMENT

SCALE (A3) 1:7,000 FIG No. FIGURE 8 REV 1

Appendix B Record of site visits

Record of site visits

Date	Site visit purpose
10/03/2025	Terrestrial and Freshwater
11/03/2025	Terrestrial and Freshwater
12/03/2025	Terrestrial and Freshwater
13/03/2025	Freshwater
17/03/2025	Terrestrial
28/03/2025	Terrestrial
02/05/2025	Terrestrial
13/06/2025	Terrestrial and Freshwater
16/06/2025	Freshwater
31/07/2025	Freshwater
26/08/2025	Freshwater
03/09/2025	Freshwater
04/09/2025	Freshwater
03/10/2025	Freshwater
07/10/2025	Freshwater
08/10/2025	Freshwater
09/10/2025	Freshwater
15/10/2025	Terrestrial and Freshwater
16/10/2025	Freshwater
03/11/2025	Terrestrial and Freshwater
04/11/2025	Terrestrial and Freshwater
05/11/2025	Terrestrial and Freshwater
12/12/2025	Terrestrial and Freshwater
17/12/2025	Terrestrial
10/02/2026	Terrestrial and Freshwater
10/06/2026	Terrestrial and Freshwater
04/08/2026	Terrestrial and Freshwater

Note: * Individuals supporting experienced Ecologist.

Appendix B Table 1: Records of lizard and terrestrial invertebrate search effort

Date	Lizard search method	Location and habitat description
17/03/2025	Manual habitat searches – 3 Person hours	Covenant bush, targeting suitable microhabitat for native skinks and invertebrates across the understory. Searches focussed on non-destructive habitat searching.
28/03/2025	Manual habitat searches – 3 Person hours	Tree privet/kānuka treeland, cutover pine, targeting microhabitat including coarse woody debris, pampas clumps, rank grass.
03/11/2025	Manual habitat searches: 4 person hours	SEA/Regenerating tree fern/broadleaf forest targeting areas of deep leaf litter, coarse woody debris, and soft root matting.
03/11/2025	Nocturnal spotlight survey: 4 person hours	SEA/Regenerating tree fern/broadleaf forest.
04/11/2025	Manual habitat searches: 4 person hours	SEA/Regenerating tree fern/broadleaf forest targeting areas of deep leaf litter, coarse woody debris, and soft root matting.
04/11/2025	Nocturnal spotlight survey: 5 person hours	SEA/Regenerating tree fern/broadleaf forest.
05/11/2025	Manual habitat searches: 4 person hours	SEA/Regenerating tree fern/broadleaf forest targeting areas of deep leaf litter, coarse woody debris, and soft root matting.
05/11/2025	Nocturnal spotlight survey: 3 person hours	SEA/Regenerating tree fern/broadleaf forest.

Note:

Appendix C Ecological Impact Assessment Guidelines

Appendix C Table 1: Factors to consider in scoring sites values in relation to species representativeness, rarity, diversity and pattern, and ecological context (adapted from EIANZ, 2018)

Value	Species values	Vegetation/Habitat values
Very High	Nationally threatened – endangered, critical, or vulnerable.	Supporting more than one national priority type. Nationally Threatened species found or likely to occur there, either permanently or occasionally.
High	Nationally At Risk– declining.	Supporting one national priority type or naturally uncommon ecosystem and/or a designated SEA in a regional or District Plan. At Risk - Declining species found or likely to occur there, either permanently or occasionally.
Moderate-high	Nationally At Risk– recovering, relict, or naturally uncommon.	A site that meets ecological significance criteria as set out the relevant regional or district policies and plans.
Moderate	Not nationally threatened or At Risk, but locally uncommon or rare.	A site that does not meet ecological significance criteria but that contributes to local ecosystem services (e.g. water quality or erosion control).
Low	Not threatened nationally, common locally.	Nationally or locally common with a low or negligible contribution to local ecosystem services.

Appendix C Table 2: Ecological values assigned to terrestrial habitats (adapted from EIANZ, 2018)

Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community	
Matters	**Attributes to be considered**
Representativeness	Attributes for representative vegetation and aquatic habitats: 1 Typical structure and composition. 2 Indigenous species dominate. 3 Expected species and tiers are present. Attributes for representative species and species assemblages: 1. Species assemblages that are typical of the habitat. Indigenous species that occur in most of the guilds expected for the habitat type.
Rarity/distinctiveness	Attributes for rare/distinctive vegetation and habitats: 1 Naturally uncommon, or induced scarcity. 2 Amount of habitat or vegetation remaining. 3 Distinctive ecological features. 4 National priority for protection. Attributes for rare/distinctive species or species assemblages:

Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community	
	1 Habitat supporting nationally Threatened or At-Risk species, or locally uncommon species. 2 Regional or national distribution limits of species or community. 3 Unusual species or assemblages. Endemism.
Diversity and Pattern	1 Level of natural diversity, abundance, and distribution. 2 Biodiversity reflecting underlying diversity. 3 Biogeographical considerations – pattern, complexity. Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation.
Ecological context	1 Site history, and local environmental conditions which have influenced the development of habitats and communities. 2 The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in the RMA). 3 Size, shape, and buffering. 4 Condition and sensitivity to change. 5 Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material. Species role in ecosystem functioning – high level, key species identification, habitat as proxy.

Appendix C Table 3: Scoring for sites or areas combining values for four matters in Appendix C Table 2

Value	Description
Very High	Area rates High for three or all the four assessment matters listed in Appendix C Table 2: Ecological values assigned to terrestrial habitats (adapted from EIANZ, 2018). Likely to be nationally important and recognised as such.
High	Area rates High for two of the assessment matters, Moderate and Low for the remainder, or Area rates High for one of the assessment maters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for two or more assessment matters Low or Very Low for the remainder Likely to be important at the level of the Ecological District.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Very Low for three matters and Low or Very Low for remainder.

Appendix C Table 4: Factors to consider in scoring ecological freshwater values (adapted from Roper-Lindsay et al., 2018)

Value	Explanation	Characteristics
Very High	A reference quality watercourse in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants from human induced activities including agriculture. Negligible degradation e.g. stream within a native forest catchment.	Benthic invertebrate community typically has high diversity, species richness and abundance. Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments. Benthic community typically with no single dominant species or group of species. MCI scores typically 120 or greater. EPT richness and proportion of overall benthic invertebrate community typically high. SEV scores high, typically >0.8. Fish communities typically diverse and abundant. Riparian vegetation typically with a well-established closed canopy. Stream channel and morphology natural. Stream banks natural typically with limited erosion. Habitat natural and unmodified.
High	A watercourse with high ecological or conservation value but which has been modified through loss of riparian vegetation, fish barriers, and stock access or similar, to the extent it is no longer reference quality. Slight to moderate degradation e.g. exotic forest or mixed forest/agriculture catchment.	Benthic invertebrate community typically has high diversity, species richness and abundance. Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments. Benthic community typically with no single dominant species or group of species. MCI scores typically 80-100 or greater. EPT richness and proportion of overall benthic invertebrate community typically moderate to high. SEV scores moderate to high, typically 0.6-0.8. Fish communities typically diverse and abundant. Riparian vegetation typically with a well-established closed canopy. No pest or invasive fish (excluding trout and salmon) species present. Stream channel and morphology natural. Stream banks natural typically with limited erosion. Habitat largely unmodified.
Moderate	A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Moderate to high degradation e.g. high-intensity agriculture catchment.	Benthic invertebrate community typically has low diversity, species richness and abundance. Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. Benthic community typically with dominant species or group of species. MCI scores typically 40-80. EPT richness and proportion of overall benthic invertebrate community typically low. SEV scores moderate, typically 0.4-0.6.

Value	Explanation	Characteristics
		Fish communities typically moderate diversity of only 3-4 species. Pest or invasive fish species (excluding trout and salmon) may be present. Stream channel and morphology typically modified (e.g. channelised). Stream banks may be modified or managed and may be highly engineered and/or evidence of significant erosion. Riparian vegetation may have a well-established closed canopy. Habitat modified.
Low	A highly modified watercourse with poor diversity and abundance of aquatic fauna and significant water quality issues. Very high degradation e.g. modified urban stream.	Benthic invertebrate community typically has low diversity, species richness and abundance. Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. Benthic community typically with dominant species or group of species. MCI scores typically 60 or lower. EPT richness and proportion of overall benthic invertebrate community typically low or zero. SEV scores low to moderate, typically less than 0.4. Fish communities typically low diversity of only 1-2 species. Pest or invasive fish (excluding trout and salmon) species present. Stream channel and morphology typically modified (e.g. channelised). Stream banks often highly modified or managed and maybe highly engineered and/or evidence of significant erosion. Riparian vegetation typically without a well-established closed canopy. Habitat highly modified.

Appendix C Table 5: Summary of the criteria for describing the magnitude of effect (EIANZ, 2018)

Magnitude	Heading
Very High	Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature.

Magnitude	Heading
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature.
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature.
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature.

Note: Baseline conditions are defined as 'the conditions that would pertain in the absence of a proposed action' (Roper-Lindsay et al., 2018).

Appendix C Table 6: Timescale for duration of effect (EIANZ, 2018)

Timescale	Description
Permanent	Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years).
Long-term	Where there is likely to be substantial improvement after a 25-year period (e.g. the replacement of mature trees by young trees that need >25 years to reach maturity, or restoration of ground after removal of a development) the effect can be termed 'long term'.
Temporary[1]	Long term (15-25 years or longer – see above). Medium term (5-15 years). Short term (up to 5 years). Construction phase (days or months).

Note: [1]Note that in the context of some planning documents, 'temporary' can have a defined timeframe.

Appendix C Table 7: Criteria for describing overall levels of ecological effects (EIANZ, 2018)

Magnitude of effect	Ecological value				
	Very high	High	Moderate	Low	Negligible
Very High	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

Note: Overall level-of-effect categories are used to determine if residual effects management is required over and above measures to reduce the severity of effects through efforts to avoid, remedy or minimise adverse effects. Usually, if the level of residual effect is assessed as being "Moderate" or greater, this warrants efforts to offset or compensate for these effects.

Appendix D ECR multipliers and staging assumptions

Below is the standard ECR calculation formula provided in Storey et al. (2011), applied to determine quantum of freshwater offset.

ECR = [(SEVi-P – SEVi-I) / (SEVm-P – SEVm-C)] × 1.5

Where:

- SEVi-P is the potential SEV value for the site to be impacted.
- SEVi-I is the predicted SEV value of the stream to be impacted after impact.
- SEVm-C is the current SEV value for the site where environmental compensation is applied.
- SEVm-P is the potential SEV value for the site where environmental compensation is applied.
- 1.5 is the standard multiplier to account for time lags before the full benefits of offset (i.e. stream restoration) measures are realised, and/or differences between expected and actual offset outcomes. (Refer below for how this was applied in this assessment.)
- Restoration length required = (impact area × ECR) / restoration channel width

Specific to this assessment:

- SEVi-I was assumed to be 0, as streams will be removed within the quarry footprint or will lose sufficient flow that they will be considered ephemeral (lost).
- The 1.5 multiplier was adjusted as detailed in Appendix D Table 1, depending on the assumed timing of impact relative to implementation of offset measures (Appendix D Table 2).

Appendix D Table 1: Assumptions for ECR multipliers used in ECR/SEV calculations

Timing of impact (assume impact at beginning of stage)	Time of offset activity - years prior to impact[1]	Stage of full potential[2]	ECR multiplier used
Stage 1 (impacts at year 0)	0	Zero	1.5
Stage 1.5 (impacts at year 5)	5	1/4 potential	1.38
Stage 1.75 (impacts at year 7)	7	0.35 of potential	1.33
Stage 2 (impacts at year 10)	10	Half potential	1.25
Stage 2.5 (impacts at year 15)	15	3/4 potential	1.13
Stage 3 (impacts at year 20)	20	Full potential	1.0
Stage 4 (impacts at year 30)	30	Full potential	1.0
Stage 5 (impacts at year 40)	40	Full potential	1.0

[1]Assumes all planting/offset happens as soon as practicable, and no more than 3 years, after commencement of consent . If planting at impact, ECR will be 1.5 for all scenarios.

[2]Full potential refers to the stage where modelled SEV outcomes (ie SEVm-P) are fully delivered/achieved. Assumes 20 years post-planting.

Appendix D Table 2: Assumptions for staging used in ECR calculations

Stream / Catchment	Staging used for ECR calcs	Rationale
OBDA	Stage 1	OBDA to be filled within Stage 1
Stream 1	As per design stage of impact	-
Stream 2 large tributary	Stage 1.75	Stream removal within the footprint begins at Stage 1. Based on current info, likely to be lost around 7 years (treatment wetland won't be ready until then) so assume "stage 1.75".
Stream 2 main stem	Stage 2.5	Impacts begin Stage 2 (loss of side of the catchment mid-reach) but no direct removal until stage 3, so assume most impacts happen somewhere between ("stage 2.5").
Stream 2a	As per design stage of impact	-
Stream 3	As per design stage of impact	-

Appendix E Plant species list

Common name	Scientific name	Location observed		National conservation status (de Lange et al 2024)	Regional conservation status (Simpkins et al. 2025)
		Regenerating tree fern/broadleaf forest	Covenant bush		
Ponga	*Alsophila dealbata*	Y	Y	Not Threatened	Not Threatened
Hen and chicken fern	*Asplenium bulbiferum*	N	Y	Not Threatened	Not Threatened
Drooping spleenwort	*Asplenium flaccidum*	Y	Y	Not Threatened	Not Threatened
Shining spleenwort	*Asplenium oblongifolium*	Y	Y	Not Threatened	Not Threatened
Sickle spleenwort	*Asplenium polyodon*	Y	Y	Not Threatened	Not Threatened
Tank lily	*Astelia hastata*	N	Y	Not Threatened	Not Threatened
Lance fern	*Austroblechnum lanceolatum*	N	Y	Not Threatened	Not Threatened
Taraire	*Beilschmiedia tarairi*	N	Y	Not Threatened	Not Threatened
Tawa	*Beilschmiedia tawa*	N	Y	Not Threatened	Not Threatened
Rangiora	*Brachyglottis repanda*	N	Y	Not Threatened	Not Threatened
Hook sedge	*Carex uncinata*	Y	Y	Not Threatened	Not Threatened
Large leaved karamū	*Coprosma autumnalis*	N	Y	Not Threatened	Not Threatened
Shining karamū	*Coprosma lucida*	Y	N	Not Threatened	Not Threatened
Karamū	*Coprosma robusta*	Y	Y	Not Threatened	Not Threatened
Karaka	*Corynocarpus laevigatus*	N	Y	Not Threatened	Not Threatened
Rimu	*Dacrydium cupressinum*	N	Y	Not Threatened	Not Threatened
Fragrant fern	*Dendroconche scandens*	Y	Y	Not Threatened	Not Threatened
Wheki	*Dicksonia squarrosa*	Y	N	Not Threatened	Not Threatened
Kohekohe	*Didymocheton spectabilis*	N	Y	Not Threatened	Not Threatened

Common name	Scientific name	Location observed		National conservation status (de Lange et al 2024)	Regional conservation status (Simpkins et al. 2025)
		Regenerating tree fern/broadleaf forest	Covenant bush		
	Diplazium australe	Y	N	Not Threatened	Not Threatened
Rasp fern	*Doodia australis*	Y	N	Not Threatened	Not Threatened
Hīnau	*Elaeocarpus dentatus*	N	Y	Not Threatened	Not Threatened
Parataniwha	*Elatostema rugosum*	N	Y	Not Threatened	Not Threatened
Kiekie	*Freycinetia banksii*	N	Y	Not Threatened	Not Threatened
Hangehange	*Geniostoma ligustrifolium*	Y	Y	Not Threatened	Not Threatened
Puka	*Griselinia lucida*	N	Y	Not Threatened	Not Threatened
Porokaiwhiri	*Hedycarya arborea*	Y	Y	Not Threatened	Not Threatened
Drooping filmy fern	*Hymenophyllum demissum*	N	Y	Not Threatened	Not Threatened
Rewarewa	*Knightia excelsa*	Y	Y	Not Threatened	Not Threatened
Hairy fern	*Lastreopsis hispida*	N	Y	Not Threatened	Not Threatened
Crêpe fern	*Leptopteris hymenophylloides*	N	Y	Not Threatened	Not Threatened
Mangemange	*Lygodium articulatum*	N	Y	Not Threatened	Not Threatened
Māhoe	*Melicytus ramiflorus*	Y	Y	Not Threatened	Not Threatened
White rātā	*Metrosideros diffusa*	N	Y	Not Threatened	Not Threatened
Akatea	*Metrosideros perforata*	N	Y	Not Threatened	Not Threatened
Northern rātā	*Metrosideros robusta*	N	Y	Not Threatened	Not Threatened
Meadow rice grass	*Microlaena stipoides*	Y	N	Not Threatened	Not Threatened
Lace fern	*Paesia scaberula*	Y	N	Not Threatened	Not Threatened
Kawakawa	*Piper excelsum*	Y	Y	Not Threatened	Not Threatened
King fern	*Ptisana salicina*	Y	Y	At Risk – Declining	At Risk – Declining

Common name	Scientific name	Location observed		National conservation status (de Lange et al 2024)	Regional conservation status (Simpkins et al. 2025)
		Regenerating tree fern/broadleaf forest	Covenant bush		
Leather-leaf fern	*Pyrrosia eleagnifolia*	Y	Y	Not Threatened	Not Threatened
Nīkau	*Rhopalostylis sapida*	N	Y	Not Threatened	Not Threatened
Supplejack	*Ripogonum scandens*	N	Y	Not Threatened	Not Threatened
Patē	*Scheflerra digitata*	Y	Y	Not Threatened	Not Threatened
Mamaku	*Sphaeropteris medullaris*	Y	N	Not Threatened	Not Threatened
Fork fern	*Tmesipteris lanceolata*	Y	Y	Not Threatened	Not Threatened
Pūriri	*Vitex lucens*	N	Y	Not Threatened	Not Threatened
Hound's tongue	*Zealandia pustulata*	Y	Y	Not Threatened	Not Threatened

Appendix F SEV function scores and SEV/ECR modelling assumptions

Function category	Report section*	Function	Worksheet #	SEV site (new name)	Stream 1 Tributary 1		Stream 1 SEA Tributary		Stream 2 US		Stream 2 DS		Stream 2 (Regenerating bush)		Stream 2a		Stream 3 5B		Stream 3 OB		Stream 3 East (ET)		Stream 3 West (WT)		Stream 3 Main Stem (DS_4)	
				Variable (code)	Northern Stream SEA Trib (Western) (SEVi-C)	Northern Stream SEA Trib (Western) (SEVi-C)	Northern Trib1 (SEVi-C)	Northern Trib1 (SEVi-P)	Southern Stream US (Zone 2 SEV) SEVi-C	Southern Stream US (Zone 2 SEV) SEVi-P	Southern Stream DS (SEV1) SEVi-C	Southern Stream DS (SEV1) SEVi-P	Stream 2 regen bush (SEVi-C)	Stream 2 regen bush (SEVi-P)	Stream 2a SEVi-C	Stream 2 SEVi-P	Stream 5 INT trib (site 5B) SEVi-C	Stream 5 INT trib (site 5B) SEVi-P	Stream 5 INT trib (site 5B) SEVi-C	Stream 5 INT trib (site 5B) SEVi-P	Offset Stream 5 INT (site 1) SEVm-C	Offset Stream 5 INT (site 1) SEVm-P	Offset Stream 5 INT site 3 (SEVm-C)	Offset Stream 5 INT site 3 (SEVm-P)	Offset Stream 5 main stem DS (site 4) (SEVm-C)	Offset Stream 5 main stem DS (site 4) (SEVm-P)
				Vchann	0.50	0.50	0.75	0.75	0.40	0.73	0.40	0.73	1.00	1.00	0.40	0.73	0.40	0.67	0.40	0.67	0.70	0.80	0.94	0.95	0.90	0.90
				Vlining	1.00	1.00	0.92	0.98	0.94	0.99	0.80	0.95	0.84	0.96	0.80	0.90	0.80	0.94	0.80	0.94	0.88	0.94	0.80	0.90	0.80	0.90
				Vpipe	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hydraulic	**4.1**	**NFR**		**=**	**0.67**	**0.67**	**0.81**	**0.83**	**0.58**	**0.81**	**0.53**	**0.80**	**0.95**	**0.99**	**0.53**	**0.78**	**0.53**	**0.76**	**0.53**	**0.76**	**0.76**	**0.85**	**0.89**	**0.93**	**0.87**	**0.90**
				Vbank	0.20	0.20	0.60	0.60	0.20	0.20	1.00	1.00	1.00	1.00	0.84	0.84	0.20	0.20	0.20	0.20	1.00	1.00	1.00	1.00	0.84	0.84
				Vrough	0.80	1.00	0.77	1.00	0.31	0.80	0.52	0.80	0.75	0.90	0.26	0.80	0.31	0.80	0.31	0.80	0.56	0.80	0.32	0.80	0.37	0.72
Hydraulic	**4.2**	**FLE**		**=**	**0.16**	**0.20**	**0.46**	**0.60**	**0.06**	**0.16**	**0.52**	**0.80**	**0.75**	**0.90**	**0.21**	**0.67**	**0.06**	**0.16**	**0.06**	**0.16**	**0.56**	**0.80**	**0.32**	**0.80**	**0.31**	**0.60**
				Vbarr	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hydraulic	**4.3**	**CSM**		**=**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
				Vchansha	0.60	0.60	0.80	0.80	0.90	0.88	0.90	0.88	1.00	1.00	0.90	0.88	0.90	0.85	0.90	0.85	0.95	0.94	0.99	0.98	0.92	0.92
				Vlining	1.00	1.00	0.92	0.98	0.94	0.99	0.80	0.95	0.84	0.96	0.80	0.90	0.80	0.94	0.80	0.94	0.88	0.94	0.80	0.90	0.80	0.90
Hydraulic	**4.4**	**CGW**		**=**	**0.87**	**0.87**	**0.88**	**0.92**	**0.93**	**0.95**	**0.83**	**0.93**	**0.89**	**0.97**	**0.83**	**0.89**	**0.83**	**0.91**	**0.83**	**0.91**	**0.90**	**0.94**	**0.86**	**0.93**	**0.84**	**0.91**
Hydraulic function mean score					**0.67**	**0.68**	**0.79**	**0.84**	**0.64**	**0.73**	**0.72**	**0.88**	**0.90**	**0.97**	**0.65**	**0.84**	**0.61**	**0.71**	**0.61**	**0.71**	**0.81**	**0.90**	**0.77**	**0.91**	**0.75**	**0.85**
				Vshade	0.80	0.96	0.76	0.96	0.40	0.80	0.26	0.70	0.78	0.90	0.58	0.80	0.70	0.80	0.70	0.80	0.76	0.80	0.20	0.60	0.20	0.50
biogeochi	**4.5**	**WTC**		**=**	**0.80**	**0.96**	**0.76**	**0.96**	**0.40**	**0.80**	**0.26**	**0.70**	**0.78**	**0.90**	**0.58**	**0.80**	**0.70**	**0.80**	**0.70**	**0.80**	**0.76**	**0.80**	**0.20**	**0.60**	**0.20**	**0.50**
				Vdod	1.00	1.00	1.00	1.00	0.68	1.00	0.60	1.00	1.00	1.00	0.68	1.00	0.60	1.00	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00
biogeochi	**4.6**	**DOM**		**=**	**1.00**	**1.00**	**1.00**	**1.00**	**0.68**	**1.00**	**0.60**	**1.00**	**1.00**	**1.00**	**0.68**	**1.00**	**0.60**	**1.00**	**0.60**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
				Vripar	1.00	1.00	0.90	1.00	0.05	1.00	0.45	1.00	1.00	1.00	0.05	1.00	0.05	1.00	0.05	1.00	0.70	1.00	0.20	1.00	0.20	0.90
				Vdecid	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
biogeochi	**4.7**	**OMI**		**=**	**1.00**	**1.00**	**0.90**	**1.00**	**0.05**	**1.00**	**0.45**	**1.00**	**1.00**	**1.00**	**0.05**	**1.00**	**0.05**	**1.00**	**0.05**	**1.00**	**0.70**	**1.00**	**0.20**	**1.00**	**0.20**	**0.90**
				Vmacro	1.00	1.00	1.00	1.00	0.99	0.99	0.78	0.97	0.50	0.50	0.99	0.99	0.90	0.98	0.90	0.98	0.92	0.98	1.00	1.00	0.99	0.99
				Vretain	0.80	0.80	0.90	0.90	0.20	0.75	0.20	0.75	1.00	1.00	0.20	0.75	0.20	0.70	0.20	0.70	0.60	0.78	0.92	0.95	0.96	0.96
biogeochi	**4.8**	**IPR**		**=**	**0.80**	**0.80**	**0.90**	**0.90**	**0.20**	**0.75**	**0.20**	**0.75**	**0.50**	**0.50**	**0.20**	**0.75**	**0.20**	**0.70**	**0.20**	**0.70**	**0.60**	**0.78**	**0.92**	**0.95**	**0.96**	**0.96**
				Vsurf	0.59	0.74	1.00	1.00	0.37	0.49	0.99	0.97	0.46	0.95	0.48	0.54	0.38	0.46	0.38	0.46	0.47	0.64	0.42	0.52	0.40	0.50
				Vripfilt	0.80	0.90	0.60	0.80	0.25	0.60	0.47	0.60	0.60	0.80	0.21	0.60	0.25	0.60	0.25	0.60	0.50	0.60	0.28	0.60	0.32	0.54
biogeochi	**4.9**	**DOP**		**=**	**0.70**	**0.82**	**0.80**	**0.90**	**0.31**	**0.55**	**0.73**	**0.78**	**0.53**	**0.88**	**0.35**	**0.57**	**0.31**	**0.53**	**0.31**	**0.53**	**0.48**	**0.62**	**0.35**	**0.56**	**0.36**	**0.52**
Biogeochemical function mean score					**0.86**	**0.92**	**0.87**	**0.95**	**0.33**	**0.82**	**0.45**	**0.85**	**0.76**	**0.86**	**0.37**	**0.82**	**0.37**	**0.81**	**0.37**	**0.81**	**0.71**	**0.84**	**0.53**	**0.82**	**0.54**	**0.78**
				Vgalspwn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40	0.28	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.55	0.40	0.40
				Vgalqual	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.75
				Vgobspwr	0.10	0.10	0.20	0.20	1.00	1.00	1.00	1.00	0.80	1.00	0.10	0.10	0.20	0.20	0.20	0.20	1.00	1.00	1.00	1.00	1.00	1.00
habitat pr	**4.10**	**FSH**		**=**	**0.05**	**0.05**	**0.10**	**0.10**	**0.50**	**0.50**	**0.50**	**0.50**	**0.55**	**0.65**	**0.05**	**0.05**	**0.10**	**0.10**	**0.10**	**0.10**	**0.50**	**0.50**	**0.50**	**0.71**	**0.50**	**0.65**
				Vphyshab	0.85	0.93	0.72	0.88	0.41	0.69	0.61	0.82	0.95	1.00	0.51	0.71	0.52	0.69	0.52	0.69	0.77	0.85	0.60	0.81	0.67	0.81
				Vwatqual	0.90	0.98	0.63	0.98	0.17	0.65	0.14	0.60	0.49	0.70	0.26	0.65	0.27	0.65	0.27	0.65	0.63	0.65	0.20	0.55	0.20	0.50
				Vimperv	0.70	0.70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.70	0.70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
habitat pr	**4.11**	**HAF**		**=**	**0.83**	**0.89**	**0.77**	**0.93**	**0.50**	**0.76**	**0.59**	**0.81**	**0.85**	**0.93**	**0.49**	**0.69**	**0.58**	**0.76**	**0.58**	**0.76**	**0.79**	**0.84**	**0.60**	**0.79**	**0.64**	**0.78**
Habitat provision function mean score					**0.44**	**0.47**	**0.43**	**0.52**	**0.50**	**0.63**	**0.55**	**0.66**	**0.70**	**0.79**	**0.27**	**0.37**	**0.34**	**0.43**	**0.34**	**0.43**	**0.65**	**0.67**	**0.55**	**0.75**	**0.57**	**0.72**
				Vfish	0.96	0.96	0.96	0.96	0.57	0.57	0.57	0.00	0.57	0.00	0.00	0.00	0.80	0.00	0.80	0.00	0.46	0.46	0.46	0.46	0.80	0.00
Biodivers	**4.12**	**FFI**		**=**	**0.96**	**0.96**	**0.96**	**0.96**	**0.57**	**0.57**	**0.57**	**0.00**	**0.57**	**0.00**	**0.00**	**0.00**	**0.80**	**0.00**	**0.80**	**0.00**	**0.46**	**0.46**	**0.46**	**0.46**	**0.80**	**0.00**
				Vmci	0.93	#DIV/0!	0.93	#DIV/0!	0.88	#DIV/0!	0.76	#DIV/0!	0.76	#DIV/0!	0.96	#DIV/0!	0.41	#DIV/0!	0.41	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.76	#DIV/0!
				Vept	0.91	0.00	0.91	#VALUE!	0.83	#VALUE!	1.00	#VALUE!	1.00	#VALUE!	1.00	#VALUE!	0.17	#VALUE!	0.17	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	1.00	#VALUE!
				Vinvert	0.41	0.00	0.41	1.00	0.23	1.00	0.47	1.00	0.47	1.00	0.35	1.00	0.12	1.00	0.12	1.00	1.00	1.00	1.00	1.00	0.47	1.00
Biodivers	**4.13**	**IFI**		**=**	**0.75**	**#DIV/0!**	**0.75**	**#DIV/0!**	**0.65**	**#DIV/0!**	**0.74**	**#DIV/0!**	**0.74**	**#DIV/0!**	**0.77**	**#DIV/0!**	**0.23**	**#DIV/0!**	**0.23**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**0.74**	**#DIV/0!**
				Vripcond	0.60	0.80	0.56	0.80	0.13	0.60	0.24	0.60	0.65	0.70	0.11	0.60	0.13	0.60	0.13	0.60	0.31	0.60	0.14	0.60	0.16	0.54
				Vripconn	1.00	1.00	0.50	0.50	0.80	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	0.80
Biodivers	**4.14**	**RVI**		**=**	**0.60**	**0.80**	**0.28**	**0.40**	**0.10**	**0.48**	**0.24**	**0.60**	**0.65**	**0.70**	**0.11**	**0.60**	**0.13**	**0.60**	**0.13**	**0.60**	**0.31**	**0.60**	**0.14**	**0.60**	**0.13**	**0.43**
Biodiversity function mean score					**0.77**	**#DIV/0!**	**0.66**	**#DIV/0!**	**0.44**	**#DIV/0!**	**0.52**	**#DIV/0!**	**0.65**	**#DIV/0!**	**0.29**	**#DIV/0!**	**0.39**	**#DIV/0!**	**0.39**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**0.56**	**#DIV/0!**
					0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Overall mean SEV score (maximu					0.73	#DIV/0!	0.74	#DIV/0!	0.47	#DIV/0!	0.55	#DIV/0!	0.77	#DIV/0!	0.42	#DIV/0!	0.44	#DIV/0!	0.44	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.61	#DIV/0!
Overall mean SEV score (excl. IFI and FFI)					**0.71**	**0.75**	**0.72**	**0.79**	**0.44**	**0.73**	**0.54**	**0.81**	**0.79**	**0.87**	**0.42**	**0.73**	**0.42**	**0.69**	**0.42**	**0.69**	**0.70**	**0.81**	**0.58**	**0.82**	**0.58**	**0.76**

Function category	Report section*	Function	Worksheet #	Stream 3 5B Stream 5 INT trib (site 5B) SEVm-C	Stream 3 5B Stream 5 INT trib (site 5B) SEVm-P	Stream 3 OB Stream 5 Overburden site INT SEVm-C	Stream 3 OB Stream 5 Overburden site INT SEVm-P
				0.40	0.63	0.53	0.69
				0.80	0.90	0.82	0.91
				1.00	1.00	1.00	1.00
Hydraulic	4.1	NFR		**0.53**	**0.72**	**0.63**	**0.76**
				0.20	0.20	0.92	0.92
				0.31	0.80	0.55	0.80
Hydraulic	4.2	FLE		**0.06**	**0.16**	**0.51**	**0.74**
				1.00	1.00	1.00	1.00
Hydraulic	4.3	CSM		**1.00**	**1.00**	**1.00**	**1.00**
				0.90	0.89	0.89	0.89
				0.80	0.90	0.82	0.91
Hydraulic	4.4	CGW		**0.83**	**0.90**	**0.84**	**0.90**
		Hydraulic function m		**0.61**	**0.69**	**0.74**	**0.85**
				0.70	0.80	0.78	0.80
biogeoch	4.5	WTC		**0.70**	**0.80**	**0.78**	**0.80**
				0.60	1.00	1.00	1.00
biogeoch	4.6	DOM		**0.60**	**1.00**	**1.00**	**1.00**
				0.05	1.00	0.60	1.00
				1.00	1.00	1.00	1.00
biogeoch	4.7	OMI		**0.05**	**1.00**	**0.60**	**1.00**
				0.90	0.98	0.88	0.98
				0.20	0.57	0.42	0.68
biogeoch	4.8	IPR		**0.20**	**0.57**	**0.42**	**0.68**
				0.38	0.43	0.44	0.49
				0.25	0.60	0.48	0.60
biogeoch	4.9	DOP		**0.31**	**0.52**	**0.46**	**0.54**
		Biogeochemical function m		**0.37**	**0.78**	**0.65**	**0.80**
				0.00	0.00	0.36	0.36
				0.00	0.00	0.00	0.25
				0.20	0.20	0.80	0.20
habitat pr	4.10	FSH		**0.10**	**0.10**	**0.40**	**0.14**
				0.52	0.69	0.62	0.76
				0.27	0.65	0.49	0.65
				1.00	1.00	1.00	1.00
habitat pr	4.11	HAF		**0.58**	**0.76**	**0.68**	**0.79**
		Habitat provision function m		**0.34**	**0.43**	**0.54**	**0.47**
				0.00	0.00	1.00	1.00
Biodivers	4.12	FFI		**0.00**	**0.00**	**1.00**	**1.00**
				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
				0.00	0.00	#VALUE!	#VALUE!
				0.00	0.00	1.00	1.00
Biodivers	4.13	IFI		**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
				0.13	0.60	0.30	0.60
				1.00	1.00	0.90	0.90
Biodivers	4.14	RVI		**0.13**	**0.60**	**0.27**	**0.54**
		Biodiversity function m		**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
				0.00	**0.00**	**0.00**	**0.00**
Overall mean SEV score (maximu				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
		Overall mean SEV score (excl. IF		**0.42**	**0.68**	**0.63**	**0.74**

Function category	Variable	**Northern Stream SEA trib (Western) (NS_SEA)** **SEVi-C: 0.71** **SEVi-P: 0.75**	**Northern Stream Trib 1 (NS_T1)** **SEVi-C: 0.72** **SEVi-P: 0.79**	**Southern Stream US (SS_US)** **SEVi-C: 0.44** **SEVi-P: 0.73**	**Southern Stream DS (SS_DS)** **SEVi-C: 0.54** **SEVi-P: 0.81**	**Southern Stream DS regen (SS_Regen)** **SEVi-C: 0.79** **SEVi-P: 0.87**	**Stream 2a (S2)** **SEVi-C: 0.42** **SEVi-P: 0.73**	**Stream 3 Impact Site Overburden (S5_OB)** **SEVi-C: 0.63** **SEVi-P: 0.76**	**Stream 3 Impact Site 5B (S5_5B)** **SEVi-C: 0.42** **SEVi-P: 0.69**	**Offset Stream 5 main stem site 4 (S5_DS_4)** **SEVm-C: 0.58** **SEVm-P: 0.76**	**Offset Stream 5 INT site 3 (west) (S5_WT)** **SEVm-C: 0.58** **SEVm-P: 0.82**	**Offset Stream 3 INT site 1 (east) (S5_ET)** **SEVm-C: 0.70** **SEVm-P: 0.81**	**Stream 3 Impact Site Overburden (S5_OB)** **SEVm-C: 0.63** **SEVm-P: 0.74**	**Stream 3 Impact Site 5B (S5_5B)** **SEVm-C: 0.42** **SEVm-P: 0.68**
		Assumes: Pest animal and plant control and stock exclusion across entire catchment. Assumes 20 year timeframe. Site located in SEA with existing low diversity regenerating bush.	Assumes: Pest animal and plant control and stock exclusion across entire catchment. Riparian planting in headwaters situated in ex-forestry area. Assumes 20 year timeframe. Note 2018 consented quarrying activity in upstream catchment.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity will reduce upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity in upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks (noting existing vegetation, assume natives retained and exotics removed) + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity in upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole of catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole catchment planted. Not affected by 2018 consented quarry expansion.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole catchment planted. Not affected by 2018 consented quarry expansion.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Proposed offset site using impact site SEV data as representative of the offset stream reach. Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Proposed offset site using impact site SEV data as representative of the offset stream reach. Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.
Hydraulic	Vchann	Assumes no change. Historic incision is unlikely to change.	Assumes no change. Whilst incision rates are expected to reduce with upstream planting to become more aligned with the natural processess of the stream, historic incision will remain.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Upstream catchment area and source of slash reduced by consented quarry activities. Assuming there is some incision obscured by the slash.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Upstream catchment area and source of slash reduced by consented quarry activities. Assuming there is some incision obscured by the slash.	No change - already natural channel.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Upstream catchment area and source of slash reduced by consented quarry activities. Assuming there is some incision obscured by the slash.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Assuming there is some incision obscured by the slash.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Assuming there is some incision obscured by the slash.	Assumes no change. Whilst incision rates are expected to reduce with planting to become more aligned with the natural processess of the stream, historic incision will remain.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Assuming there is some incision obscured by the slash.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Assuming there is some incision obscured by the slash.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Assuming there is some incision obscured by the slash.	Assumes that over the next 20 years some slash will be flushed downstream reducing effect of increasing in roughness elements, some will remain/be incorporated into the channel. Assuming there is some incision obscured by the slash.
	Vlining	Assumes no change. 100% of the channel is already natural with no modification.	Assumes decrease in fine sediments due to increased filtering by further established vegetation and riparian margin planting in the headwaters. and flushing over time. Consented quarrying activity upstream to reduce upstream catchment area and source of sediment inputs.	Assumes decrease in fine sediments due to increased filtering by riparian margin planting and flushing over time. Consented quarry to reduce some upstream catchment area and source of fine sediments.	Assumes decrease in fine sediments due to increased filtering by riparian margin planting and flushing over time. Consented quarry to reduce some upstream catchment area and source of fine sediments.	Assumes decrease in fine sediments due to increased filtering by more established riparian margin planting and flushing over time. Consented quarry to reduce some upstream catchment area and source of fine sediments.	Assumes decrease in fine sediments due to increased filtering by riparian margin planting and flushing over time.	Assumes decrease in fine sediments due to increased filtering by riparian margin planting and flushing over time.	Assumes decrease in fine sediments due to increased filtering by riparian margin planting and flushing over time.	Assumes decrease in fine sediments due to decreased sediment inputs from riparian margins, and reduced bank erosion. Some inputs remain due to history of forestry activity.	Assumes decrease in fine sediments due to decreased sediment inputs from riparian margins, and reduced bank erosion. Some inputs remain due to history of forestry activity.	Assumes decrease in fine sediments due to decreased sediment inputs from riparian margins, and reduced bank erosion. Some inputs remain due to history of forestry activity.	Assumes decrease in fine sediments due to decreased sediment inputs from riparian margins, and reduced bank erosion. Some inputs remain due to history of forestry activity.	Assumes decrease in fine sediments due to decreased sediment inputs from riparian margins, and reduced bank erosion.Some inputs remain due to history of forestry activity.
	Vpipe	Assumes no change	Assumes no change	Assumes no change.	Assumes no change	Assumes no change	Assumes no change.	Assumes no change	Assumes no change	Assumes no change	Assumes no change	Assumes no change	Assumes no change	Assumes no change	Assumes no change
	Vbank	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	No change - already unrestricted movement of flood flows.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.	Assumes no change in hydrological connectivity as existing incision is unlikely to change.
	Vrough	Assumes that with pest control over a 20 year period, the vegetation surrounding the stream will reach late-stage succession. It is unlikely to reach maturity with a diverse canopy and understorey in the given timeframe.	Assumes that with pest control over a 20 year period, the vegetation surrounding the stream will reach late-stage succession. It is unlikely to reach maturity with a diverse canopy and understorey in the given timeframe.	Assumes 20 m planting of low diversity native regenerating bush.	Assumes 20 m planting of low diversity native regenerating bush.	Assumes 20 m planting, existing exotics removed and replaced with low diversity native regenerating bush. Existing native vege matures to late successional.	Assumes 20 m planting of low diversity native regenerating bush.	Assumes increase due to 20 m riparian margin of native planting. Will remain low diversity regenerating bush within the modelled timeframe.	Assumes increase due to 20 m riparian margin of native planting.	Assumes 20 m planting of low diversity native regenerating bush excluding 10% of margin which is either bedrock or too steep to plant.	Assumes increase due to 20 m riparian margin of native planting. Will remain low diversity regenerating bush within the modelled timeframe.	Assumes increase due to 20 m riparian margin of native planting. Will remain low diversity regenerating bush within the modelled timeframe.	Assumes increase due to 20 m riparian margin of native planting. Will remain low diversity regenerating bush within the modelled timeframe.	Assumes increase due to 20 m riparian margin of native planting. Will remain low diversity regenerating bush within the modelled timeframe.
	Vbarr	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.
	Vchanshape	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.
	Vshade	Another 20 years of bush establishment will likely result in mostly very high shading due to the further establishment of the canopy and understorey.	Another 20 years of bush establishment will likely result in mostly very high shading due to the further establishment of the canopy and understorey.	Assumes slash will clear but native planting will establish, resulting in high shading when combined with the topography.	Assumes slash will clear but native planting will establish, resulting in 50/50 high/moderate shading when combined with the topography and wide stream.	Assume very high/high 50/50 as canopy cover of existing vegetation develops further.	Assumes slash will clear but native planting will establish, resulting in high shading when combined with the topography.	Assumes slash will clear but native planting will establish, resulting in high shading when combined with the topography. The slash currently results very high shading in 5 cross sections, however this will not remain as some of the slash is flushed downstream.	Assumes slash will clear but native planting will establish, resulting in 100% high shading when combined with the topography.	Assumes increase to 50:50 low:moderate shading due to 20 m riparian margin enhancement. Unlikely to achieve more than moderate as bedrock and steep banks prevent planting right on the stream margin. The wetted width is also 2.8m wide on average making it hard to get full shade.	Assumes increase to moderate shading due to 20 m riparian margin enhancement, limited shading from topography. Unlikely to achieve more than moderate (up to 70% shading) in 20 year timeframe.	Assumes slashcurrently providing shade will mostly clear but native planting will establish, resulting in high shading when combined with the topography.	Assumes some slash currently providing shade will clear but native planting will establish, resulting in high shading when combined with the topography.	Assumes some slash currently providing shade will clear but native planting will establish, resulting in high shading when combined with the topography.
	Vdod	Already optimal, assumes no change.	Already optimal, assumes no change.	Assumes that increased shading and filtering from native planting establishment will improve the water quality.	Assumes that increased shading and filtering from native planting establishment will improve the water quality.	Assumes no change. Already high.	Assumes that increased shading and filtering from native planting establishment will improve the water quality.	Already optimal, assumes no change.	Assumes that increased shading and filtering from native planting establishment will improve the water quality.	Already optimal, assumes no change.	Already optimal, assumes no change.	Already optimal, assumes no change.	Already optimal, assumes no change.	Assumes that increased shading and filtering from native planting establishment will improve the water quality.
	Vveloc	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.
	Vdepth	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.	Assumes no change.

		Northern Stream SEA trib (Western) (NS_SEA) **SEVi-C: 0.71** **SEVi-P: 0.75**	**Northern Stream Trib 1 (NS_T1)** **SEVi-C: 0.72** **SEVi-P: 0.79**	**Southern Stream US (SS_US)** **SEVi-C: 0.44** **SEVi-P: 0.73**	**Southern Stream DS (SS_DS)** **SEVi-C: 0.54** **SEVi-P: 0.81**	**Southern Stream DS regen (SS_Regen)** **SEVi-C: 0.79** **SEVi-P: 0.87**	**Stream 2a (S2)** **SEVi-C: 0.42** **SEVi-P: 0.73**	**Stream 3 Impact Site Overburden (S5_OB)** **SEVi-C: 0.63** **SEVi-P: 0.76**	**Stream 3 Impact Site 5B (S5_5B)** **SEVi-C: 0.42** **SEVi-P: 0.69**	**Offset Stream 5 main stem site 4 (S5_DS_4)** **SEVm-C: 0.58** **SEVm-P: 0.76**	**Offset Stream 5 INT site 3 (west) (S5_WT)** **SEVm-C: 0.58** **SEVm-P: 0.82**	**Offset Stream 3 INT site 1 (east) (S5_ET)** **SEVm-C: 0.70** **SEVm-P: 0.81**	**Stream 3 Impact Site Overburden (S5_OB)** **SEVm-C: 0.63** **SEVm-P: 0.74**	**Stream 3 Impact Site 5B (S5_5B)** **SEVm-C: 0.42** **SEVm-P: 0.68**
Function category	**Variable**	Assumes: Pest animal and plant control and stock exclusion across entire catchment. Assumes 20 year timeframe. Site located in SEA with existing low diversity regenerating bush.	Assumes: Pest animal and plant control and stock exclusion across entire catchment. Riparian planting in headwaters situated in ex-forestry area. Assumes 20 year timeframe. Note 2018 consented quarrying activity in upstream catchment.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity will reduce upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity in upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks (noting existing vegetation, assume natives retained and exotics removed) + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity in upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole of catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole catchment planted. Not affected by 2018 consented quarry expansion.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole catchment planted. Not affected by 2018 consented quarry expansion.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Proposed offset site using impact site SEV data as representative of the offset stream reach. Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Assumes full catchment restored/retired from forestry.	Proposed offset site using impact site SEV data as representative of the offset stream reach. Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.
Biogeochemical	Vripar	Assumes no change, banks already 100% trees and bush.	Assumes increase to 100%.	Assumes increase due to 20 m riparian margin of native planting.	Assumes increase due to 20 m riparian margin of native planting.	No change, already fully vegetated to 20 m.	Assumes increase due to 20 m riparian margin of native planting.	Assumes increase due to 20 m riparian margin of native planting.	Assumes increase due to 20 m riparian margin of native planting.	Assumes increase due to 20 m riparian margin of native planting (excluding bedrock and unplantable steep banks).	Assumes increase due to 20 m riparian margin of native planting.	Assumes increase due to 20 m riparian margin of native planting.	Assumes increase due to 20 m riparian margin of native planting.	Assumes increase due to 20 m riparian margin of native planting.
	Vdecid	Assumes 100% evergreen in line with the current vegetation types present.	Assumes 100% evergreen in line with the current vegetation types present.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.	Assumes 100% evergreen due to native riparian planting.
	Vmacro	Assumes no change, macrophyte volume already 0 and unlikely to increase with more shading.	Assumes no change, macrophyte volume already 0 and unlikely to increase with more shading.	Assumes no change as macrophyte volume already very low.	Assumes that the increase in shading due to riparian planting will greatly decrease macrophyte volume.	No change - already low	Assumes no change as macrophyte volume already very low.	Assumes that theslight increase in shading due to riparian planting will result in a slight decrease in macrophyte volume.	Assumes that the increase in shading due to riparian planting will result in a decrease in macrophyte volume.	Assumes no change as macrophyte volume already very low.	Assumes no change, no macrophytes at present, unlikely to increase with more shading.	Assumes reduction in macrophyte volume due to increased shading from native planting.	Assumes that theslight increase in shading due to riparian planting will result in a slight decrease in macrophyte volume.	Assumes that the increase in shading due to riparian planting will result in a decrease in macrophyte volume.
	Vretain	Auto populated.	Auto populated.	Auto populated.	Auto populated.		Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.
	Vsurf	Assumes slight reduction in silt/sand due to the further establishment of the vegetation increasing filtering activity, which is also likely to result in a slight increase in organic matter (leaf litter) and wood inputs. Small increase in tree roots as vegetation matures.	Assumes slight reduction in silt/sand due to the further vegetation establishment across the catchment and riparian planting in the headwaters increasing filtering activity. Lots of wood and leaf litter present within the stream already, so this is unlikely to change significantly despite the vegetation establishment.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Slight decrease in woody debris as slash will be flushed downstream, however there will still be wood input from the native planting establishment.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Leaf litter is already high and unlikely to change. Emergent vegetation (macrophytes) is likely to decrease due to increased shading. Slight decrease in woody debris as slash will be flushed downstream, however there will still be wood input from the native planting establishment.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Increase in leaf litter and roots. Slight increase in woody debris due to more established planting.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Slight decrease in woody debris as slash will be flushed downstream, however there will still be wood input from the native planting establishment.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Slight decrease in woody debris as slash will be flushed downstream, however there will still be wood input from the native planting establishment. Reduction in submerged macrophyte colume due to increased shading.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Slight decrease in woody debris as slash will be flushed downstream, however there will still be wood input from the native planting establishment. Reduction in submerged macrophyte colume due to increased shading.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Woody debris unlikely to change as forestry slash already present in stream.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Slight decrease in woody debris due to the planting.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Slight decrease in woody debris due to slash clearing over time.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Slight decrease in woody debris due to slash clearing over time.	Assumes reduction in silt/sand due to riparian planting increasing filtering activity and reduced erosion. Slight increase in organic matter (leaf litter) due to native riparian planting. Slight decrease in woody debris due to slash clearing over time.
	Vripfilt	Assumes that the further establishment and maturation of the bush will increase filtering activity to 50/50 high/very high.	Assumes that the further establishment and maturation of the bush will increase filtering activity to high.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Improves from moderate to high as existing riparian vege matures.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.	Assumes the 20 m of native planting (regerating bush) will result in moderate filtering.
Habitat provision	Vgalspwn	Assumes no change in bank gradient.	Assumes no change in bank gradient.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting and no change in existing incision.	Assumes no change in bank gradient following riparian planting and no change in existing incision.
	Vgalqual	The banks are too steep for galaxid spawning, assume this won't change.	The banks are too steep for galaxid spawning, assume this won't change.	The banks are too steep for galaxid spawning, assume this won't change.	The banks are too steep for galaxid spawning, assume this won't change.	The banks are moderately steep for galaxid spawning, assume this won't change.	The banks are too steep for galaxid spawning, assume this won't change.	Assume increase in shading making the 10m of flat surface suitable for galaxid spawning (medium).	The banks are too steep for galaxid spawning, assume this won't change.	Assume increase in shading making the 10m of flat surface suitable for galaxid spawning (medium).	Assume increase in shading making the 10m of flat surface suitable for galaxid spawning (medium).	No flat surface suitable for galaxid spawning.	Assume increase in shading making the 10m of flat surface suitable for galaxid spawning (medium).	The banks are too steep for galaxid spawning, assume this won't change.
	Vgobspwn	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.
	Vphyshab	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.	Aquatic habitat diversity and abundance, hydrologic heterogeneity remains unchanged as already high. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.	Assumes no change in aquatic habitat diversity and abundance as these are already high, with planting unlikely to significantly increase habitat provision within stream. Same for hydrological heterogeneity, which is also already high. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight change in aquatic habitat diversity, no change in abundance, or hydro heterogeneity as these are already high and increased planting is unlikely to change this. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight change in aquatic habitat diversity, no change in abundance, or hydro heterogeneity as these are already high and increased planting is unlikely to change this. Assumes a slight increase in channel shading and improved vegetation integrity.	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.	Assumes slight increase in aquatic habitat diversity and abundance as a result of riparian vegetation maturing, hydrologic heterogeneity remains unchanged. Assumes increase in channel shading and improved vegetation integrity.

Function category	Variable	**Northern Stream SEA trib (Western) (NS_SEA) SEVi-C: 0.71 SEVi-P: 0.75**	**Northern Stream Trib 1 (NS_T1) SEVi-C: 0.72 SEVi-P: 0.79**	**Southern Stream US (SS_US) SEVi-C: 0.44 SEVi-P: 0.73**	**Southern Stream DS (SS_DS) SEVi-C: 0.54 SEVi-P: 0.81**	**Southern Stream DS regen (SS_Regen) SEVi-C: 0.79 SEVi-P: 0.87**	**Stream 2a (S2) SEVi-C: 0.42 SEVi-P: 0.73**	**Stream 3 Impact Site Overburden (S5_OB) SEVi-C: 0.63 SEVi-P: 0.76**	**Stream 3 Impact Site 5B (S5_5B) SEVi-C: 0.42 SEVi-P: 0.69**	**Offset Stream 5 main stem site 4 (S5_DS_4) SEVm-C: 0.58 SEVm-P: 0.76**	**Offset Stream 5 INT site 3 (west) (S5_WT) SEVm-C: 0.58 SEVm-P: 0.82**	**Offset Stream 3 INT site 1 (east) (S5_ET) SEVm-C: 0.70 SEVm-P: 0.81**	**Stream 3 Impact Site Overburden (S5_OB) SEVm-C: 0.63 SEVm-P: 0.74**	**Stream 3 Impact Site 5B (S5_5B) SEVm-C: 0.42 SEVm-P: 0.68**
		Assumes: Pest animal and plant control and stock exclusion across entire catchment. Assumes 20 year timeframe. Site located in SEA with existing low diversity regenerating bush.	Assumes: Pest animal and plant control and stock exclusion across entire catchment. Riparian planting in headwaters situated in ex-forestry area. Assumes 20 year timeframe. Note 2018 consented quarrying activity in upstream catchment.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity will reduce upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity in upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks (noting existing vegetation, assume natives retained and exotics removed) + pest animal and plant control and stock exclusion. Based on 20 years post-planting. 2018 consented quarrying activity in upstream catchment area. Assumes whole of remaining catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole of catchment planted.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole catchment planted. Not affected by 2018 consented quarry expansion.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes whole catchment planted. Not affected by 2018 consented quarry expansion.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.	Proposed offset site using impact site SEV data as representative of the offset stream reach. Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Assumes full catchment restored/retired from forestry.	Proposed offset site using impact site SEV data as representative of the offset stream reach. Assumes: 20 m riparian margin enhancement on both banks + pest animal and plant control and stock exclusion. Based on 20 years post-planting. Assumes full catchment restored/retired from forestry.
	Vwatqual	Already well shaded, no change expected.	Riparian planting in the headwaters will increase overall shading to 'well-shaded'.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes upper catchment remains partially shaded (already shaded due to slash presence) as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.	Assumes increase to partially shaded as whole catchment planted. Unlikely to achieve well shaded in a time frame of 20 years.
	Vimperv	Assumes slight increase in impervious surface upstream due to quarry expansion but not to the extent that >10% of the upstream catchment is impervious.	The currently consented quarry expansion is set to impact part of the headwaters which could result in 10-25% of the cathcment being impervious with low runoff controls (=0.3)	No impervious surfaces to be created upstream (unless overburden site has impermeable lining).	Part of the catchment (trib approx 100m upstream of SEV site) is within the currently consented quarry footprint which may become impermeable surface. This is not likely to exceed 10% of the catchment area.	Assumes no change.	No impervious surfaces to be created upstream (unless overburden site has impermeable lining).	No impervious surfaces to be created upstream.	No impervious surfaces to be created upstream.	No impervious surfaces to be created upstream (unless overburden site has impermeable lining).	No impervious surfaces to be created upstream.	No impervious surfaces to be created upstream (unless overburden site has impermeable lining).	No impervious surfaces to be created upstream.	No impervious surfaces to be created upstream.
Biodiversity	Vfish	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vmci	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vept	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vinvert	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vripcond	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.	Auto populated.
	Vripconn	Assumes no change. Further incision not expected.	Assumes no change. Further incision not expected.	Assumes no change. Further incision not expected but existing incision unlikely to change.	Assumes no change. Further incision not expected.	Assumes no change. Fully unimpeded.	Assumes no change. Not currently impeded.	Assumes no change. Further incision not expected.	Assumes no change. Further incision not expected.	Assumes no change. Further incision not expected.	Assumes no change. Further incision not expected.	Assumes no change. Further incision not expected.	Assumes no change. Further incision not expected.	Assumes no change. Further incision not expected.

Appendix G SEV cross-section photographs

Stream 1 Tributary 1

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Stream 1 SEA Tributary

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Stream 2 US

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Stream 2 DS

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Stream 2 Regenerating Bush

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

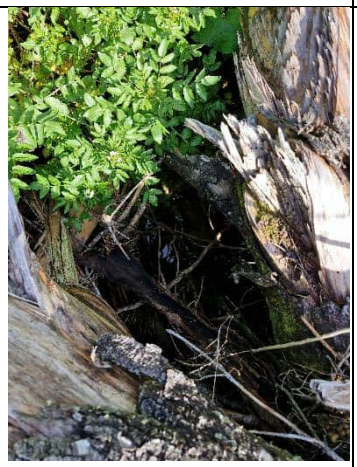
Stream 2a

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

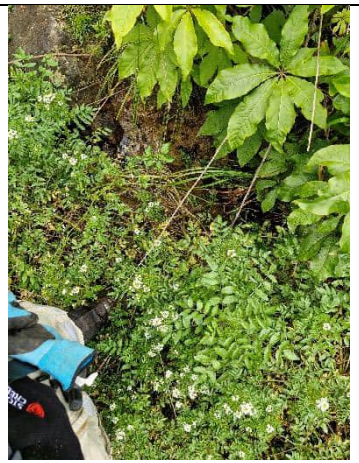
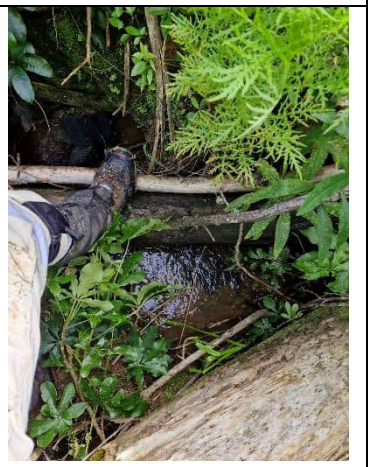
Stream 3 Site 5B

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Stream 3 Overburden (OB)

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Stream 3 East Tributary

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Stream 3 West Tributary

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Stream 3 Main Channel

				
Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4	Cross-section 5
				
Cross-section 6	Cross-section 7	Cross-section 8	Cross-section 9	Cross-section 10

Appendix H Macroinvertebrate laboratory results

Appendix H Table 1: Summary of macroinvertebrate community metrics

Site	Sampling protocol	Total richness	%EPT richness	%EPT abundance	MCI	QMCI	MCI-sb	QMCI-sb
Stream 1 SEA Tributary	Soft-bottom	12	33.33	48.37	-	-	127.17	7.8
Stream 2 US	Soft-bottom	13	38.46	49.57	-	-	119.23	5.99
Stream 2 DS	Hard/soft-bottom mix[1]	15	66.67	22.84	98.67	**3.83**	108.8	**3.71**
Stream 2a	Soft-bottom	10	60	92.11	-	-	113.60	7.47
Stream 3 Overburden (OB)	Soft-bottom	14	42.86	29.41	-	-	125.43	5.97
Stream 3 Site 5B	Soft-bottom	15	6.67	0.84	-	-	77.20	3.36

[1] The sample reach started hard-bottomed then transitions to soft-bottomed along the surveyed reach, therefore both C1 and C2 sampling protocols were used and results for both metrics are presented.

New Name						Stream 2 DS	Stream 1 SEA Trib	Stream 2 US	Stream 2a	Stream 3 5B	Stream 3 OB
Date Sampled						13/03/2025	16/06/2025	3/10/2025	3/10/2025	3/10/2025	3/11/2025
Customer Sample ID						Southern Stream	Northern Stream SEA trib	South Stream (Area 2)	Stream 2 (Area 7)	Stream 5 (Area 5b)	Overburden A
Protocol						P2	P2	P2	P2	P2	P2
Classification				MCI Tolerance Value		Counts	Counts	Counts	Counts	Counts	Counts
				Hard Bottom	Soft Bottom						
INSECTA											
EPHEMEROPTERA				MCI TV	MCI-sb TV						
Acanthophlebia				7	9.6						
Ameletopsis				10	10						
Arachnocolus				8	8.1						
Atalophlebioides				9	4.4						
Austroclima				9	6.5						
Austronella				7	4.7						
Coloburiscus				9	8.1	1			3		
Deleatidum				8	5.6	15		8			
Icthybotus				8	9.2						
Isothraulus				8	7.1						
Mauiulus				5	4.1						
Neozephlebia				7	7.6		40		68		
Nesameletus				9	8.6						
Oniscigaster				10	5.1						
Rallidens				9	3.9						
Siphlaenigma				9							
Tepakia				8	7.6						
Zephlebia				7	8.8	11	56	38	60		24
PLECOPTERA											
Acroperla				5	5.1						1
Austroperla				9	8.4						3
Cristaperla				8							
Halticoperla				8							
Megaleptoperla				9	7.3						
Nesoperla				5	5.7						
Spaniocerca				8	8.8						
Spaniocercoides				8							
Stenoperla				10	9.1						
Taraperla				7	8.3						
Zelandobius				5	7.4						
Zelandoperla				10	8.9						
TRICHOPTERA											
Alloecentrella				9							
Aoteapsyche				4	6				3		
Beraeoptera				8	7						
Confluens				5	7.2						
Conuxia				8							
Costachorema				7	7.2						
Cryptobiosella				9							
Diplectrona				9							
Ecnominidae				8							
Ecnomina				8	9.6						
Edpercivalia				9	6.3						
Helicopsyche				10	8.6						
Hudsonema				6	6.5						
Hydrobiosella				9	7.6						
Hydrobiosis				5	6.7						
Hydrochorema				9							
Kokiria				9							
Neurochorema				6	6						
Oecetis				6	6.8						
Oeconesidae				9	6.4			7		4	3
Olinga				9	7.9						
Orthopsyche				9	7.5	15		4			

New Name						Stream 2 DS	Stream 1 SEA Trib	Stream 2 US	Stream 2a	Stream 3 5B	Stream 3 OB
Date Sampled						13/03/2025	16/06/2025	3/10/2025	3/10/2025	3/10/2025	3/11/2025
Customer Sample ID						Southern Stream	Northern Stream SEA trib	South Stream (Area 2)	Stream 2 (Area 7)	Stream 5 (Area 5b)	Overburden A
Protocol						P2	P2	P2	P2	P2	P2
Classification				MCI Tolerance Value		Counts	Counts	Counts	Counts	Counts	Counts
				Hard Bottom	Soft Bottom						
Oxyethira				2	1.2						
Paroxyethira				2	3.7						
Philorheithrus				8	5.3						
Plectrocnemia				8	6.6						
Polyplectropus				8	8.1	2					1
Psilochorema				8	7.8	2		1	1		3
Pycnocentrella				9					5		
Pycnocentria				7	6.8						
Pycnocentrodes				5	3.8						
Rakiura				10							
Synchorema				9							
Tiphobiosis				6	9.3						
Triplectides				5	5.7						
Triplectidina				5							
Zelandoptila				8	7						
Zelolessica				10	6.5						
MEGALOPTERA											
Archichauliodes				7	7.3						
ODONATA											
Aeshna				5	1.4						
Anisoptera				5	6						
Antipodochlora				6	6.3						
Austrolestes				6	0.7						
Hemianax					1.1						
Hemicordulia				5	0.4						
Ischnura					3.1					1	
Procordulia				6	3.8						
Uropetala				5	0.4						
Xanthocnemis				5	1.2						
HEMIPTERA											
Anisops				5	2.2						
Diaprepocoris				5	4.7						
Microvelia				5	4.6		9			15	
Saldidae				5	3.9						
Sigara				5	2.4						
COLEOPTERA											
Antiporus				5	3.5						
Berosus				5							
Copelatus				5	3.7						
Dytiscidae				5	0.4						
Elmidae				6	7.2						
Enochrus				5	2.6						
Hydraenidae				8	6.7						
Hydrophilidae				5	8						
Liodessus				5	4.9						
Onychohydrus				5							
Podaena				8							
Ptilodactylidae				8	7.1			4			
Rhantus				5	1						
Scirtidae				8	6.4			1		10	
Staphylinidae				5	6.2						
NEUROPTERA											
Kempynus				5							
DIPTERA											
Anthomyiidae				3							
Aphrophila				5	5.6						

New Name						Stream 2 DS	Stream 1 SEA Trib	Stream 2 US	Stream 2a	Stream 3 5B	Stream 3 OB
Date Sampled						13/03/2025	16/06/2025	3/10/2025	3/10/2025	3/10/2025	3/11/2025
Customer Sample ID						Southern Stream	Northern Stream SEA trib	South Stream (Area 2)	Stream 2 (Area 7)	Stream 5 (Area 5b)	Overburden A
Protocol						P2	P2	P2	P2	P2	P2
Classification				MCI Tolerance Value		Counts	Counts	Counts	Counts	Counts	Counts
				Hard Bottom	Soft Bottom						
Austrosimulium				3	3.9	1					
Calopsectra				4							
Ceratopogonidae				3	6.2						
Chironomidae				2	3.8						
Chironomus				1	3.4	3				2	
Corynoneura				2	1.7						
Cryptochironomus				3							
Culex				3							
Culicidae				3	1.2						
Diptera indet.				3	2.9						
Dixidae				4	7.1						
Dolichopodidae				3	8.6						
Empididae				3	5.4						
Ephydridae				4	1.4						
Eriopterini				9	7.5						
Harrisius				6	4.7						
Hexatomini				5	6.7				1	6	
Limnophora				3	4.5						
Limonia				6	6.3						4
Lobodiamesa				5	7.7						
Maoridiamesa				3	4.9						
Mischoderus				4	5.9						
Molophilus				5	6.3		1	2			
Muscidae				3	1.6						
Nannochorista				7							
Neocurupira				7							
Neolimnia				3	5.1						
Neoscatella				7							
Nothodixa				4	9.3	1	40	3			
Orthocladiinae				2	3.2					35	
Parochlus				8							
Paradixa				4	8.5						
Paralimnophila				6	7.4						
Paucispinigera				6	7.7						
Pelecorhyncidae				9							
Peritheates				7							
Podonominae				8	6.4						
Polypedilum				3	8	2	37		2		30
Psychodidae				1	6.1						
Scatella				7							
Sciomyzidae				3	3						
Stictocladius				9							
Stratiomyidae				5	4.2						
Syrphidae				1	1.6						
Tabanidae				3	6.8						
Tanypodinae				5	6.5						
Tanytarsini				3	4.5						
Tanytarsus				3							
Thaumaleidae				9	8.8						
Tipulidae				5	3.4						
Zelandotipula				6	3.6						
LEPIDOPTERA											
Hygraula				4	1.3						
Collembola				6	5.3		3			115	
ACARINA				5	5.2						1
ARACHNIDA											

New Name			Stream 2 DS	Stream 1 SEA Trib	Stream 2 US	Stream 2a	Stream 3 5B	Stream 3 OB
Date Sampled			13/03/2025	16/06/2025	3/10/2025	3/10/2025	3/10/2025	3/11/2025
Customer Sample ID			Southern Stream	Northern Stream SEA trib	South Stream (Area 2)	Stream 2 (Area 7)	Stream 5 (Area 5b)	Overburden A
Protocol			P2	P2	P2	P2	P2	P2
Classification	MCI Tolerance Value		Counts	Counts	Counts	Counts	Counts	Counts
	Hard Bottom	Soft Bottom						
Dolomedes	5	6.2						
CRUSTACEA								
Amphipoda	5	5.5		4	5		5	1
Cladocera	5	0.7						
Copepoda	5	2.4						
Halicarcinus		5.1						
Helice		6.6						
Isopoda	5	4.5						
Mysidae		6.4						
Ostracoda	3	1.9	10				135	26
Paracalliope	5							
Paraleptamphopus	5							
Paranephrops	5	8.4						
Paranthura		4.9						
Paratya	5	3.6						
Tanaidacea	4	6.8						
MOLLUSCA								
Ampullariidae	3	1.6						
Glyptophysa = Physastra	5	0.3						
Gundlachia = Ferrissia	3	2.4	1					
Gyraulus	3	1.7				2	16	
Hyridella = Echyridella	3	6.7						
Latia	3	6.1						
Lymnaeidae	3	1.2						
Melanopsis = Zemelanopsis	3	1.9						
Physa = Physella	3	0.1						
Potamopyrgus	4	2.1	99		13	7	63	
Sphaeriidae	3	2.9					3	
OLIGOCHAETA	1	3.8	68	16	28		54	17
POLYCHAETA		6.7						
PLATYHELMINTHES			1		3		11	
HIRUDINEA	3	1.2		1				
ANALYSIS								
Percentage counted			25	75	100	100	75	100
Number of taxa (incl. missed taxa)			15	12	13	10	15	14
Number of missed taxa			2	1	0	0	0	0
Number of individuals			232	215	117	152	475	119
%EPT richness (excl. Hydroptilidae)			66.67	33.33	38.46	60.00	6.67	42.86
%EPT abundance (excl. Hydroptilidae)			22.84	48.37	49.57	92.11	0.84	29.41
MCI			98.67	103.33	121.54	118.00	77.33	107.14
QMCI			3.83	5.18	5.24	6.80	3.81	4.13
MCI-sb			108.80	127.17	119.23	113.60	77.20	125.43
QMCI-sb			3.71	7.8	5.99	7.47	3.36	5.97

Appendix I Freshwater fish community

Appendix I Table 1: Fish and large freshwater invertebrates detected in Stream 1 catchment

Common name	Scientific name	National threat classification (Dunn et al. 2025; Grainger et al., 2018)	Regional threat classification (Bloxham et al., 2023)	Method of detection					
				NZFFD	2018 consent fishing (Boffa Miskell Ltd, 2017a)	eDNA – main channel downstream	eDNA – main channel upstream	eDNA – main south-ern trib down-stream	eDNA – main south-ern trib up-stream
Banded kōkopu	*Galaxias fasciatus*	At Risk-Naturally uncommon	Not Threatened	✓	✓	✓	✓		
Common bully	*Gobiomorphus cotidianus*	Not Threatened	Not Threatened			*			
Kōura; freshwater crayfish	*Paranephrops planifrons*	Not Threatened	-			*			
Longfin eel	*Anguilla dieffenbachii*	At Risk-Declining	At Risk-Declining	✓	✓	✓	✓	✓	✓
Redfin bully	*Gobiomorphus huttoni*	At Risk-Naturally uncommon	At Risk-Declining			✓			
Shortfin eel	*Anguilla australis*	Not Threatened	Not Threatened	✓		✓	✓	✓	
Speckled longfin eel	*Anguilla reinhardtii*	Introduced	Introduced			✓			
Torrentfish	*Cheimarrichthys fosteri*	At Risk-Naturally uncommon	Threatened-Vulnerable			✓			

Common name	Scientific name	National threat classification (Dunn et al. 2025; Grainger et al., 2018)	Regional threat classification (Bloxham et al., 2023)	Method of detection					
				NZFFD	2018 consent fishing (Boffa Miskell Ltd, 2017a)	eDNA – main channel downstream	eDNA – main channel upstream	eDNA – main south-ern trib down-stream	eDNA – main south-ern trib up-stream
Un-identified galaxiid	*Galaxias* sp.	-	-					*	

* 'Trace detection' based on eDNA interpretation guidelines (Melchior & Baker, 2023), refer to Section 3.1.5.4.

Appendix I Table 2: Fish and large freshwater invertebrates detected in Stream 2

Common name	Scientific name	National threat classification (Dunn et al. 2025; Grainger et al., 2018)	Regional threat classification (Bloxham et al., 2023)	Method of detection			
				NZFFD	2018 consent fishing (Boffa Miskell Ltd, 2017a)	eDNA (survey 1)	eDNA (survey 2)
Banded kōkopu	*Galaxias fasciatus*	At Risk- Naturally uncommon	Not Threatened		✓	✓	✓
Kōura; freshwater crayfish	*Paranephrops* sp.	-	-		✓	*	*
Longfin eel	*Anguilla dieffenbachii*	At Risk-Declining	At Risk-Declining			✓	✓
Shortfin eel	*Anguilla australis*	Not Threatened	Not Threatened		✓	✓	✓

Appendix I Table 3: Fish and large freshwater invertebrates detected in Stream 2a

Common name	Scientific name	National threat classification (Dunn et al. 2025; Grainger et al., 2018)	Regional threat classification (Bloxham et al., 2023)	Method of detection		
				NZFFD	2018 consent fishing (Boffa Miskell Ltd, 2017a)	eDNA
Kōura; freshwater crayfish	*Paranephrops planifrons*	Not Threatened	-		n/a	✓
Shortfin eel	*Anguilla australis*	Not Threatened	Not Threatened		n/a	✓

Appendix I Table 4: Fish and large freshwater invertebrates detected in Stream 3 catchment

Common name	Scientific name	National threat classification (Dunn et al. 2025; Grainger et al., 2018)	Regional threat classification (Bloxham et al., 2023)	NZFFD	eDNA sample 1 (50 m upstream of Wairoa River confluence)	eDNA sample 2 (50 m upstream of Wairoa River confluence)
Banded kōkopu	*Galaxias fasciatus*	At Risk- Naturally uncommon	Not Threatened		✓	✓
Common smelt	*Retropinna retropinna*	At Risk-Declining	Threatened- Vulnerable		*	
Inanga	*Galaxias maculatus*	Threatened- Nationally vulnerable	At Risk-Declining		✓	
Kōaro	*Galaxias brevipinnis*	At Risk-Declining	Threatened- Endangered			*
Kōura; freshwater crayfish	*Paranephrops planifrons* or *Paranephrops* sp.	Not Threatened	-		*	*
Longfin eel	*Anguilla dieffenbachii*	At Risk-Declining	At Risk- Declining		✓	✓

Common name	Scientific name	National threat classification (Dunn et al. 2025; Grainger et al., 2018)	Regional threat classification (Bloxham et al., 2023)	NZFFD	eDNA sample 1 (50 m upstream of Wairoa River confluence)	eDNA sample 2 (50 m upstream of Wairoa River confluence)
Rainbow trout	*Oncorhynchus mykiss*	Introduced	Introduced		✓	
Redfin bully	*Gobiomorphus huttoni*	At Risk- Naturally uncommon	At Risk- Declining		✓	
Shortfin eel	*Anguilla australis*	Not Threatened	Not Threatened		✓	✓
Torrentfish	*Cheimarrichthys fosteri*	At Risk- Naturally uncommon	Threatened- Vulnerable		✓	

Appendix J eDNA survey laboratory results (aggregated) for Amphibians, *Paranephrops* spp., and Fish

					Stream 1 main channel – downstream (2025-03-11)						Stream 3 main channel - lower (2025-03-13)						Stream 2 - survey 1 (2025-03-11)					
ScientificName	Rank	TaxID	CommonName	Group	741821	741822	741823	741824	741825	741826	741831	741832	741833	741834	741835	741836	741801	741802	741803	741804	741805	741806
Leiopelma hochstetteri	species	51644	Hochstetter's frog	Amphibian	0	0	1403	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranephrops planifrons	species	99774	Koura; freshwater crayfish; kēwai; kōura; koeke; kēkēwai; kara	Crustacean	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranephrops	genus	99773	Freshwater crayfish; koura; kēkēwai; kēwai; karawai; koeke	Crustacean	625	484	0	375	204	1735	0	0	179	0	0	0	0	0	0	220	0	0
Anguilla dieffenbachii	species	61127	Longfin eel; tuna; kūwharuwharu; reherehe; kirirua	Fish	37262	16669	35638	44886	51741	64210	0	17	13854	7565	7764	5468	8933	169	1998	25	78	0
Gobiomorphus huttoni	species	587584	Redfin bully	Fish	25966	46187	13458	76317	31004	72981	0	2600	276	9735	203	2052	0	0	0	0	0	0
Anguilla australis	species	7940	Shortfin eel; tuna; hao; aopori; hikumutu	Fish	1341	353	5820	4814	4951	7581	9	4145	49	187	10409	6542	18468	52676	28148	21198	20732	0
Galaxias fasciatus	species	89555	Banded kokopu; kokōpu	Fish	1196	13195	897	2006	0	190	0	3698	2760	2276	623	154	22504	36218	43342	19764	21356	0
Cheimarrichthys fosteri	species	206139	Torrentfish; panoko; pānokonoko; pānonoko	Fish	12429	3407	15335	12466	22385	11949	7829	12669	14060	16639	26758	6903	0	0	0	0	0	0
Galaxias maculatus	species	61620	Inanga; īnanga	Fish	0	0	0	0	0	0	6533	0	3926	2323	0	0	0	0	0	0	0	0
Oncorhynchus mykiss	species	8022	Rainbow trout; taraute;tarauta; hāmana; tāmana	Fish	0	0	0	0	0	0	0	5912	0	2576	1850	0	0	0	0	0	0	0
Anguilla reinhardtii	species	48165	Speckled longfin eel	Fish	0	0	1416	3167	0	1281	0	0	0	0	0	0	0	0	0	0	0	0
Gobiomorphus cotidianus	species	226931	Common bully; tīpokopoko; toitoi	Fish	0	0	0	0	0	5312	0	0	0	0	0	0	0	0	0	0	0	0
Retropinna retropinna	species	170203	Common smelt; ngaore; paraki; pōrohe	Fish	0	0	0	0	0	0	0	0	0	833	0	0	0	0	0	0	0	0
Gobiomorphus	genus	86236	Bullies	Fish	5635	4457	5588	9445	13351	14425	0	0	3557	1758	6384	6232	0	0	0	0	0	0
Oncorhynchus	genus	8016	Salmon/Trout; taraute;tarauta; hāmana; tāmana	Fish	0	0	0	0	0	0	0	3072	0	1030	0	4032	0	0	0	0	0	0
Anguilla	genus	7935	Eels	Fish	1158	0	320	629	1793	625	0	0	685	0	0	0	143	119	275	402	60	0
Galaxias	genus	51242	Galaxiids	Fish	0	469	0	0	0	0	0	0	89	0	94	0	0	199	895	0	440	0
Gobiiformes	order	1489878	Gobies and sleepers	Fish	0	0	0	0	0	36	0	0	0	0	0	0	0	0	0	0	0	0
Anguilliformes	order	7933	Eel; tuna	Fish	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	0

					Stream 1 main channel – upstream (4/08/2026)						Stream 1 main southern trib upstream (4/08/2026)						Stream 1 main southern trib upstream (4/08/2026)					
ScientificName	Rank	TaxID	CommonName	Group	787201	787202	787203	787204	787205	787206	787211	787212	787213	787214	787215	787216	787221	787222	787223	787224	787225	787226
Leiopelma hochstetteri	species	51644	Hochstetter's frog	Amphibian	0	0	0	0	0	2147	0	0	0	0	0	0	0	0	0	0	0	0
Anguilla dieffenbachii	species	61127	Longfin eel; tuna; kūwharuwharu; reherehe; kirirua	Fish	19490	22799	30168	31251	18163	50099	8237	3848	13783	34667	30986	10070	0	5553	0	2739	5193	0
Galaxias fasciatus	species	89555	Banded kokopu; kokōpu	Fish	4883	0	3854	4588	0	3936	0	0	0	0	0	0	0	0	0	0	0	0
Anguilla australis	species	7940	Shortfin eel; tuna; hao; aopori; hikumutu	Fish	0	0	3970	0	0	20	0	0	0	885	5911	57	0	0	0	0	0	0
Galaxias	genus	51242	Galaxiids	Fish	2343	787	0	1126	446	0	0	0	0	612	0	0	0	0	0	0	0	0
Anguilla	genus	7935	Eels	Fish	0	660	45	0	522	178	310	148	0	377	1071	0	0	0	0	0	0	0
Anguilliformes	order	7933	Eel; tuna	Fish	0	0	0	337	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					Stream 2a (2025-10-03)					
ScientificName	Rank	TaxID	CommonName	Group	741811	741812	741813	741814	741815	741816
Paranephrops planifrons	species	99774	Koura; freshwater crayfish; kēwai; kōura; koeke; kēkēwai; kara	Crustacean	0	216	143	0	0	0
Paranephrops	genus	99773	Freshwater crayfish; koura; kēkēwai; kēwai; karawai; koeke	Crustacean	109	176	535	130	272	39
Anguilla australis	species	7940	Shortfin eel; tuna; hao; aopori; hikumutu	Fish	6670	1183	18055	14981	4055	0
Anguilla	genus	7935	Eels	Fish	0	0	194	171	0	0

					Stream 2 - survey 2 (2025-11-05)						Stream 3 main channel – upstream of 'lower' sample (2025-11-03)					
ScientificName	Rank	TaxID	CommonName	Group	700951	700952	700953	700954	700955	700956	702931	702932	702933	702934	702935	702936
Paranephrops planifrons	species	99774	Koura; freshwater crayfish; kēwai; kōura; koeke; kēkēwai; kara	Crustacean	0	0	0	0	0	0	13	0	0	0	0	0
Paranephrops	genus	99773	Freshwater crayfish; koura; kēkēwai; kēwai; karawai; koeke	Crustacean	10	153	16	984	0	310	507	0	0	0	0	0
Galaxias fasciatus	species	89555	Banded kokopu; kokōpu	Fish	10373	5706	12522	20909	806	33782	3362	371	0	928	1732	934
Anguilla australis	species	7940	Shortfin eel; tuna; hao; aopori; hikumutu	Fish	3046	8019	218	10594	7982	20273	2980	746	0	10550	16229	8188
Anguilla dieffenbachii	species	61127	Longfin eel; tuna; kūwharuwharu; reherehe; kirirua	Fish	235	1137	6	2665	411	5538	11819	392	2835	17069	9967	6480
Galaxias brevipinnis	species	66447	Koaro; kōaro; maehe	Fish	0	0	0	0	0	0	0	0	0	329	0	0
Galaxias	genus	51242	Galaxiids	Fish	79	0	294	483	0	20	0	2777	0	888	0	6
Anguilla	genus	7935	Eels	Fish	525	213	0	534	0	348	0	0	211	67	124	18
Galaxiinae	subfamily	130269		Fish	0	0	0	0	68	0	0	0	0	0	1216	0
Anguilliformes	order	7933	Eel; tuna	Fish	0	0	0	109	0	42	194	0	0	22	0	0

Appendix K BOAM assumptions

BOAM 1 – overburden planting

- Restoration target WF9 (taraire, tawa, podocarp forest) based on mature vegetation present within Stream 3 catchment and Auckland Council *Te Haumanu Taiao* restoration guide (Auckland Council 2023).
- Fixed area of 4.6 ha available which will be planted from bare earth once the overburden is full (estimated to be around 10 years after consent is granted). Adjusted area of impact in impact model to reach no net loss outcome in offset model. This planting will account for 2 ha of forest loss with the residual loss of 4.3 ha addressed through BOAM 2
- Standard discount rate of 0.03. Standard restoration methods used and confidence in offset actions set as "very confident".
- Net present biodiversity values:
  - Indigenous canopy (cover, average height, basal area) – 0.19
  - Indigenous species diversity – 0.30
  - Indigenous understorey – 0.53
  - Fauna habitat/food provision (coarse woody debris, leaf litter) – 0.86
  - **Overall average – 0.47**

Biodiversity component	Biodiversity attribute	Benchmark	Impact value (onsite assessment)	Benchmark justification	Measure after offset (time until endpoint)	Measure after offset justification	Impact area	Offset area (ha)	Reference
Indigenous canopy	Canopy cover (%)	90	63	A benchmark of 90% canopy cover considers the formation of a closed canopy of dominant indigenous pioneer species including a mix of manuka/kanuka, mahoe, mapou, and other broadleaf species.	80(10)	10 years is considered an appropriate time to establish a closed canopy.	Accounts for 2 ha of the total loss of 6.1 ha of regenerating tree fern-broadleaf forest.	4.6 ha (to be planted in year 10 when overburden full)	
	Average height of indigenous canopy (m)	15	7	A benchmark of 15 metres is based on the expected canopy height of a mature WF9 taraire, tawa, podocarp forest	5(15)	Based on the growth rates of common broadleaf species, including kohekohe.			Tanes Tree Trust (2011)

Biodiversity component	Biodiversity attribute	Benchmark	Impact value (onsite assessment)	Benchmark justification	Measure after offset (time until endpoint)	Measure after offset justification	Impact area	Offset area (ha)	Reference
	Basal area (m2/ha)	70	89	A benchmark of 70m2/ha has been chosen based on a range of data available for secondary broadleaf forest and forest succession.	30(20)	Basal area expected to increase rapidly between 0 and 20 years and level off once vegetation begins to mature and canopy closure occurs.			Richardson et al (2014)
Indigenous diversity	Diversity of native vascular plants	44	24	A benchmark of 44 vascular plant species is based on expected diversity within a mature WF13 ecosystem.	25(20)	The impacted ecosystem has a relatively low diversity due to being a regenerating ecosystem. As such, it is likely that a similar diversity will be achieved within the 20 year restoration period, with species diversity likely to increase towards benchmark as vegetation matures.			Allen et al., (2013)
Indigenous understory	Percentage cover of indigenous understory vegetation (%)	40	20	The benchmark of 40% cover of indigenous vegetation is based on expected tier structure and diversity in mature forest ecosystems.	25(20)	A moderate cover of understory vegetation is expected at 20 years. Understorey cover will continue to develop beyond the modelled timeframe.			Smale et al (2008)
Fauna habitat provision	Coarse woody debris (m3/ha)	25	0.3	25m3/ha is considered appropriate for a WF13 reference ecosystem.	20(25)	Coarse woody debris forms naturally within a forest ecosystem over an extended time period to varying densities depending on the ecosystem type.			Smale et al (2008)
	Average leaf litter depth (mm)	40	25	40mm average leaf litter depth considered suitable for habitat provision to native lizards and invertebrates.	25(25)	It is expected that nutrient recycling and leaf litter fall in the restored ecosystem will be occurring to a reduced extent compared to a benchmark ecosystem at 25 years.			

BOAM 2 – Stream 3 catchment restoration

- Restoration target WF9 (taraire, tawa, podocarp forest) based on mature vegetation present within Stream 3 catchment and Auckland Council *Te Haumanu Taiao* restoration guide.
- Model designed to address residual loss of 4.31 ha of regenerating tree fern-broadleaf forest following BOAM1 offset actons described above. Area of offset adjusted in offset model to achieve no net loss outcome. 6 ha will be planted.
- Discount rate of 0 because restoraton will be undertaken within 1 year of commencement of consent granted and impact is not anticipated to occur for 20+ years. Standard restoration methods used and confidence in offset actions set as "very confident" . Weeds will likely be sprayed prior to planting and remaining coarse woody debris (pine slash) will be left in place where possible.
- Net present biodiversity values:
  - Canopy (cover, average height, basal area) – 0.04
  - Species diversity – 0.90
  - Percentage cover understorey – 1.43
  - Fauna habitat/food provision (coarse woody debris, leaf litter) – 2.14
  - **Overall average – 1.13**

Biodiversity component	Biodiversity attribute	Benchmark	Impact value (onsite assessment)	Benchmark justification	Measure after offset (time until endpoint)	Measure after offset justification	Impact area	Offset area (ha)	Reference
Indigenous canopy	Canopy cover (%)	90	63	A benchmark of 90% canopy cover considers the formation of a closed canopy of dominant indigenous pioneer species including a mix of manuka/kanuka, mahoe, mapou, and other broadleaf species.	80(10)	10 years is considered an appropriate time to establish a closed canopy.	**Accounts for 4.3 ha of loss of regenerating tree fern-broadleaf forest.**	6 ha (to be planted shortly after consent granted)	
	Average height of	15	7	A benchmark of 15 metres is based on the expected canopy height of a mature	5(15)	Based on the growth rates of common broadleaf species, including kohekohe.			Tanes Tree Trust (2011)

Biodiversity component	Biodiversity attribute	Benchmark	Impact value (onsite assessment)	Benchmark justification	Measure after offset (time until endpoint)	Measure after offset justification	Impact area	Offset area (ha)	Reference
	indigenous canopy (m)			WF9 taraire, tawa, podocarp forest					
	Basal area (m2/ha)	70	89	A benchmark of 70m2/ha has been chosen based on a range of data available for secondary broadleaf forest and forest succession.	30(20)	Basal area expected to increase rapidly between 0 and 20 years and level off once vegetation begins to mature and canopy closure occurs.			Richardson et al (2014)
Indigenous diversity	Diversity of native vascular plants	44	24	A benchmark of 44 vascular plant species is based on expected diversity within a mature WF13 ecosystem.	25(20)	The impacted ecosystem has a relatively low diversity due to being a regenerating ecosystem. As such, it is likely that a similar diversity will be achieved within the 20 year restoration period, with species diversity likely to increase towards benchmark as vegetation matures.			Allen et al., (2013)
Indigenous understory	Percentage cover of indigenous understory vegetation (%)	40	20	The benchmark of 40% cover of indigenous vegetation is based on expected tier structure and diversity in mature forest ecosystems.	25(20)	A moderate cover of understory vegetation is expected at 20 years. Understorey cover will continue to develop beyond the modelled timeframe.			Smale et al (2008)
Fauna habitat provision	Coarse woody debris (m3/ha)	25	0.3	25 m3/ha is considered appropriate for a WF13 reference ecosystem.	30(25)	Coarse woody debris forms naturally within a forest ecosystem over an extended time period to varying densities depending on the			Smale et al (2008)

Biodiversity component	Biodiversity attribute	Benchmark	Impact value (onsite assessment)	Benchmark justification	Measure after offset (time until endpoint)	Measure after offset justification	Impact area	Offset area (ha)	Reference
						ecosystem type. Restoration area is former pine forest so there will be reasonable quantities of coarse woody debris from year 1 meaning value after offset exceeds benchmark.			
	Average leaf litter depth (mm)	40	25	40mm average leaf litter depth considered suitable for habitat provision to native lizards and invertebrates.	25(25)	It is expected that nutrient recycling and leaf litter fall in the restored ecosystem will be occurring to a reduced extent compared to a benchmark ecosystem at 25 years.			

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Appendix L ECR Calculations

Design stage of impact	Stage of impact assumed for Offset	Impact stream number	T+T Trib ID	Representative SEV	SEVi-P	Impacted length (m) - FINAL DESIGN (*1.05 for slope adjustment)	Impacted streambed area (m2) - FINAL DESIGN (*1.05 for slope adjustment)	Offset location ID (Representative SEV ID)	SEVm-C	SEVm-P	SEV gain	Multiplier (based on stage) - planting	ECR (assumes SEVi-I = 0) - planting	Streambed area offset required (m2) - planting
Direct stream removal/loss within quarry expansion footprint and OBDA - offset calculations														
Stage 1 (OBDA)	Stage 1 (impacts at year 0)	3		S5_OB	0.76	118	44	S5_5B	0.42	0.68	0.25	1.50	4.49	199
Stage 1 (OBDA)	Stage 1 (impacts at year 0)	3		S5_OB	0.76	186	70	S5_OB	0.63	0.74	0.11	1.50	10.34	727
Stage 1 (OBDA)	Stage 1 (impacts at year 0)	3		S5_OB	0.76	161	60	S5_ET	0.70	0.81	0.11	1.50	10.03	607
Stages 1, 2, 3	Stage 1.75 (impacts at year 7)	2 (large trib)		SS_US	0.73	184	86	S5_DS_4	0.58	0.76	0.18	1.33	5.39	464
Stages 1, 2, 3	Stage 1.75 (impacts at year 7)	2 (large trib)		SS_US	0.73	66	30	S5_WT	0.58	0.82	0.24	1.33	4.03	123
Stages 1, 2, 3	Stage 1.75 (impacts at year 7)	2 (large trib)		SS_US	0.73	13	6	S5_ET	0.70	0.81	0.11	1.33	8.56	54
Stage 2	Stage 2 (impacts at year 10)	1		NS_T1	0.79	53	16	S5_ET	0.70	0.81	0.11	1.25	8.80	139
Stages 3, 4	Stage 2.5 (impacts at year 15)	2		SS_DS	0.81	334	339	S5_DS_4	0.58	0.76	0.18	1.13	5.05	1714
Stages 3, 4	Stage 2.5 (impacts at year 15)	2		SS_US	0.73	161	84	S5_DS_4	0.58	0.76	0.18	1.13	4.58	384
				Subtotal		1277	737							
Direct stream removal/loss within quarry expansion footprint and OBDA - freshwater compensation calculations[1]														
Design stage of impact	Stage of impact assumed for Offset	Impact stream number	T+T Trib ID	Representative SEV	SEVi-P	Impacted length (m) - FINAL DESIGN (*1.05 for slope adjustment)	Impacted streambed area (m2) - FINAL DESIGN (*1.05 for slope adjustment)	Compensation calculation: Offset location ID (Representative SEV ID)	Compensation calculation: SEVm-C	Compensation calculation: SEVm-P	Compensation calculation: SEV gain	Compensation calculation: Multiplier (based on stage) - planting	Compensation calculation: ECR (assumes SEVi-I = 0) - planting	Compensation calculation: Streambed area offset required (m2) - planting
Stage 1 (OBDA)	Stage 1 (impacts at year 0)	3		S5_OB	0.76	78	29	Additional site	0.58	0.76	0.18	1.50	6.34	183
Stages 3, 4	Stage 2.5 (impacts at year 15)	2		SS_US	0.73	313	160	Additional site	0.58	0.76	0.18	1.13	4.59	733
Stages 3, 4	Stage 2.5 (impacts at year 15)	2		SS_US	0.73	260	140	Additional site	0.58	0.76	0.18	1.13	4.59	641
Stage 3	Stage 3 (impacts at year 20)	2a		S2	0.73	14	2	Additional site	0.58	0.76	0.18	1.00	4.11	9
Stage 4	Stage 4 (impacts at year 30)	2a		S2	0.73	64	9	Additional site	0.58	0.76	0.18	1.00	4.11	39
Stage 4	Stage 4 (impacts at year 30)	1		NS_SEA	0.75	152	51	Additional site	0.58	0.76	0.18	1.00	4.22	217
Stage 4	Stage 4 (impacts at year 30)	3		S5_5B	0.69	30	6	Additional site	0.58	0.76	0.18	1.00	3.88	24
Stage 5	Stage 5 (impacts at year 40)	1		NS_SEA	0.75	140	44	Additional site	0.58	0.76	0.18	1.00	4.22	186
Stage 5	Stage 5 (impacts at year 40)	3		S5_5B	0.69	64	3	Additional site	0.58	0.76	0.18	1.00	3.88	12
				Subtotal		1115	445							2044
				Total direct loss		2392	1182							
Catchment reduction - direct effects (perm/int reduced to ephemeral stream) - freshwater compensation calculations[1]														
Design stage of impact	Stage of impact assumed for Offset	Impact stream number	T+T Trib ID	Representative SEV	SEVi-P	Impacted length (m) - FINAL DESIGN (*1.05 for slope adjustment)	Impacted streambed area (m2) - FINAL DESIGN (*1.05 for slope adjustment)	Compensation calculation: Offset location ID (Representative SEV ID)	Compensation calculation: SEVm-C	Compensation calculation: SEVm-P	Compensation calculation: SEV gain	Compensation calculation: Multiplier (based on stage) - planting	Compensation calculation: ECR (assumes SEVi-I = 0) - planting	Compensation calculation: Streambed area offset required (m2) - planting	Catchment area reduction notes
N/A	Stage 2.5 (impacts at year 15)	1	S1T1	NS_T1	0.79	82	33	Additional site	0.58	0.76	0.18	1.13	5.00	167	Whole reach affected
N/A	Stage 2.5 (impacts at year 15)	1	S1T2	SS_US	0.73	139	49	Additional site	0.58	0.76	0.18	1.13	4.59	226	Whole reach affected
N/A	Stage 2.5 (impacts at year 15)	1	S1T3	NS_SEA	0.75	74	36	Additional site	0.58	0.76	0.18	1.13	4.75	171	Whole reach affected
N/A	Stage 2.5 (impacts at year 15)	3	S1T3a	NS_SEA	0.75	12	4	Additional site	0.58	0.76	0.18	1.13	4.75	20	Whole reach affected
N/A	Stage 2.5 (impacts at year 15)	3	S1T3b	NS_SEA	0.75	11	3	Additional site	0.58	0.76	0.18	1.13	4.75	15	Whole reach affected
N/A	Stage 2.5 (impacts at year 15)	1	S1T4a	NS_SEA	0.75	139	48	Additional site	0.58	0.76	0.18	1.13	4.75	229	Whole reach affected
N/A	Stage 2.5 (impacts at year 15)	2a		S2	0.73	96	26	Additional site	0.58	0.76	0.18	1.13	4.62	121	Upper 1/4 affected
N/A	Stage 2.5 (impacts at year 15)	2		SS_regen	0.87	149	138	Additional site	0.58	0.76	0.18	1.13	5.48	753	Assume full reach affected
N/A	Stage 2.5 (impacts at year 15)	2		SS_DS	0.81	192	188	Additional site	0.58	0.76	0.18	1.13	5.07	953	Assume full reach affected
N/A	Stage 2.5 (impacts at year 15)	2		SS_US	0.73	108	26	Additional site	0.58	0.76	0.18	1.13	4.59	121	Assume full reach affected
N/A	Stage 2.5 (impacts at year 15)	3	S3T1	S5_5B	0.69	112	39	Additional site	0.58	0.76	0.18	1.13	4.36	170	Whole reach affected
N/A	Stage 2.5 (impacts at year 15)	3	S3T2	S5_5B	0.69	141	57	Additional site	0.58	0.76	0.18	1.13	4.36	248	Whole reach affected
N/A	Stage 2.5 (impacts at year 15)	3	S3T3	S5_5B	0.69	116	30	Additional site	0.58	0.76	0.18	1.13	4.36	131	Half of reach affected
N/A	Stage 2.5 (impacts at year 15)	3	S3T4	S5_5B	0.69	163	66	Additional site	0.58	0.76	0.18	1.13	4.36	286	Upper 3/4 affected
				Total catchment reduction		1533	744							3612	

[1] To determine the quantum of offset that would be required to address the remaining residual stream loss effects not addressed via compensation, if additional offsetting was undertaken offsite, the streambed area of a 'hypothetical' site was calculated. This is the 'additional site' presented in this table. The SEVm-C and SEVm-P scores for this 'additional site' were based on the average scores from across the Stream 3 offset sites SEVm-C and SEVm-P . Refer to Sections 6.2.1 and 6.3.4 of the EcIA.

			Proportion of length	Proportion of area	
Offset	1277	737	0.33	0.38	Offset
Compensated - loss within footprint	1115	445	0.28	0.23	compensation for footprint loss
Compensated - catchment reduction	1533	744	0.39	0.39	compensation for catchment loss
	3925	1925			

Appendix M Catchment area reductions (Tektus modelling results) catchments remaining >1.4 ha

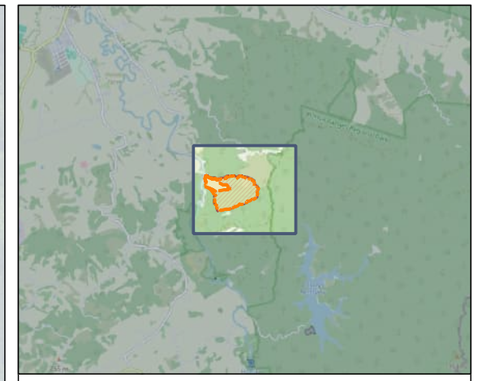
Table 1: Tektus catchment results, showing percentage of catchment area change for streams with pre- and post-expansion catchment areas of >1.4 ha. Source of data in dark blue columns: '260616 Stream Hydrology R3' Results summary spreadsheet and PDF maps, provided to T+T by Tektus on 17 June 2026.

Reach Name	Total Length (m)	Sub Reach	Reach_Subreach	Sub CH (m)	Sub Reach Length (m)	Pre Ca (m^2)	Post Ca (m^2)	Percent Change	Intermitent Pre (catchment >1.4 ha)	Intermittent Post (catchment >1.4 ha)	Intermitent Change	T+T reach ID (refer to Appendix A Figure 7)	T+T reach name
R28	93.35534	1	R28_1	23.33251	23.3	949212	740065	-22%	1	1	0	S1	Stream 1 main channel
R28	93.35534	2	R28_2	46.67086	23.3	948352	739453	-22%	1	1	0	S1	Stream 1 main channel
R28	93.35534	3	R28_3	70.0092	23.3	947354	738627	-22%	1	1	0	S1	Stream 1 main channel
R28	93.35534	4	R28_4	93.34755	23.3	945658	737153	-22%	1	1	0	S1	Stream 1 main channel
R27	90.49747	1	R27_1	22.61825	22.6	959294	749708	-22%	1	1	0	S1	Stream 1 main channel
R27	90.49747	2	R27_2	45.24215	22.6	958838	749269	-22%	1	1	0	S1	Stream 1 main channel
R27	90.49747	3	R27_3	67.86605	22.6	958316	748903	-22%	1	1	0	S1	Stream 1 main channel
R27	90.49747	4	R27_4	90.48995	22.6	956675	747262	-22%	1	1	0	S1	Stream 1 main channel
R26	35.89949	1	R26_1	8.972448	9.0	998090	786023	-21%	1	1	0	S1	Stream 1 main channel
R26	35.89949	2	R26_2	17.94714	9.0	997678	785616	-21%	1	1	0	S1	Stream 1 main channel
R26	35.89949	3	R26_3	26.92183	9.0	997039	784979	-21%	1	1	0	S1	Stream 1 main channel
R26	35.89949	4	R26_4	35.89652	9.0	994419	784829	-21%	1	1	0	S1	Stream 1 main channel
R16	258.865	1	R16_1	258.8426	258.8	240485	173041	-28%	1	1	0	S1ST3	Stream 1 main southern trib
R16	258.865	2	R16_2	129.4132	-129.4	257682	186766	-28%	1	1	0	S1ST3	Stream 1 main southern trib
R16	258.865	3	R16_3	194.1279	64.7	249259	181347	-27%	1	1	0	S1ST3	Stream 1 main southern trib
R16	258.865	4	R16_4	64.69851	-129.4	264009	193093	-27%	1	1	0	S1ST3	Stream 1 main southern trib
R106	71.76955	1	R106_1	71.76321	71.8	50929	38820	-24%	1	1	0	S1T4	Stream 1 trib
R106	71.76955	2	R106_2	53.82129	-17.9	51932	39823	-23%	1	1	0	S1T4	Stream 1 trib
R106	71.76955	3	R106_3	35.87936	-17.9	53595	41486	-23%	1	1	0	S1T4	Stream 1 trib
R106	71.76955	4	R106_4	17.93744	-17.9	54930	42821	-22%	1	1	0	S1T4	Stream 1 trib
R94	120.397	1	R94_1	120.3865	120.4	182132	158966	-13%	1	1	0	S1ST3.5	Stream 1 trib
R94	120.397	2	R94_2	90.28796	-30.1	187576	164294	-12%	1	1	0	S1ST3.5	Stream 1 trib
R94	120.397	3	R94_3	60.18946	-30.1	189111	165769	-12%	1	1	0	S1ST3.5	Stream 1 trib
R94	120.397	4	R94_4	30.09097	-30.1	191222	167880	-12%	1	1	0	S1ST3.5	Stream 1 trib
R32	126.7107	1	R32_1	31.66894	31.7	151558	136174	-10%	1	1	0	S1ST4	Stream 1 trib
R32	126.7107	2	R32_2	126.6995	95.0	135970	123861	-9%	1	1	0	S1ST4	Stream 1 trib
R32	126.7107	3	R32_3	63.3458	-63.4	142084	129471	-9%	1	1	0	S1ST4	Stream 1 trib
R32	126.7107	4	R32_4	95.02266	31.7	137742	125633	-9%	1	1	0	S1ST4	Stream 1 trib
R42	87.39697	1	R42_1	21.84321	21.8	26504	26504	0%	1	1	0	S1T4b	Stream 1 trib
R42	87.39697	2	R42_2	43.69188	21.8	24788	24788	0%	1	1	0	S1T4b	Stream 1 trib
R42	87.39697	3	R42_3	65.54055	21.8	21060	21060	0%	1	1	0	S1T4b	Stream 1 trib
R42	87.39697	4	R42_4	87.38923	21.8	19387	19387	0%	1	1	0	S1T4b	Stream 1 trib
R45	122.2548	1	R45_1	122.2447	122.2	283371	21494	-92%	1	1	0	S2	Stream 2
R45	122.2548	2	R45_2	91.6816	-30.6	288097	24583	-91%	1	1	0	S2	Stream 2
R45	122.2548	3	R45_3	61.11852	-30.6	292226	27571	-91%	1	1	0	S2	Stream 2
R45	122.2548	4	R45_4	30.55544	-30.6	299720	33840	-89%	1	1	0	S2	Stream 2
R44	64.69848	1	R44_1	64.69313	64.7	307999	41306	-87%	1	1	0	S2	Stream 2
R44	64.69848	2	R44_2	48.51884	-16.2	309261	42568	-86%	1	1	0	S2	Stream 2
R44	64.69848	1	R44_1	32.34455	32.3	310670	43977	-86%	1	1	0	S2	Stream 2
R44	64.69848	2	R44_2	16.17025	-16.2	311299	44606	-86%	1	1	0	S2	Stream 2
R110	331.7473	1	R110_1	248.7846	248.8	33132	16076	-51%	1	1	0	S2a	Stream 2a
R110	331.7473	1	R110_1	165.8495	165.8	40257	23201	-42%	1	1	0	S2a	Stream 2a
R110	331.7473	1	R110_1	82.91438	82.9	50473	33417	-34%	1	1	0	S2a	Stream 2a
R109	251.7645	1	R109_1	62.92394	62.9	683943	584712	-15%	1	1	0	S3MCT1	Stream 3 main channel
R109	251.7645	2	R109_2	251.7429	188.8	662077	566917	-14%	1	1	0	S3MCT1	Stream 3 main channel
R109	251.7645	3	R109_3	188.8033	-62.9	670174	574724	-14%	1	1	0	S3MCT1	Stream 3 main channel
R109	251.7645	4	R109_4	125.8636	-62.9	675633	580098	-14%	1	1	0	S3MCT1	Stream 3 main channel
R91	84.42641	1	R91_1	21.10083	21.1	643604	562591	-13%	1	1	0	S3MCT2	Stream 3 main channel
R91	84.42641	2	R91_2	84.41913	63.3	633382	554295	-12%	1	1	0	S3MCT2	Stream 3 main channel
R91	84.42641	1	R91_1	63.31303	63.3	634097	555010	-12%	1	1	0	S3MCT2	Stream 3 main channel
R91	84.42641	1	R91_1	42.20693	42.2	638827	559740	-12%	1	1	0	S3MCT2	Stream 3 main channel
R54	33.97056	1	R54_1	33.96756	34.0	39970	15250	-62%	1	1	0	S3T4	Stream 3 trib
R54	33.97056	2	R54_2	25.47514	-8.5	40411	15691	-61%	1	1	0	S3T4	Stream 3 trib
R54	33.97056	1	R54_1	16.98272	17.0	40661	15941	-61%	1	1	0	S3T4	Stream 3 trib
R54	33.97056	2	R54_2	8.490299	-8.5	40833	16113	-61%	1	1	0	S3T4	Stream 3 trib
R64	122.0538	1	R64_1	61.01777	61.0	33077	15886	-52%	1	1	0	S3T3	Stream 3 trib
R64	122.0538	2	R64_2	30.50507	-30.5	34661	17470	-50%	1	1	0	S3T3	Stream 3 trib

N

Wairoa River

74.96ha



LEGEND

Change in Catchment (m²/m²)
<= -0.90/1.0
-0.90 - -0.80/1.0
-0.80 - -0.70/1.0
-0.70 - -0.60/1.0
-0.60 - -0.50/1.0
-0.50 - -0.40/1.0
-0.40 - -0.30/1.0
-0.30 - -0.20/1.0
-0.20 - -0.10/1.0
> -0.10/1.0

NOTES:

REV	DETAILS	DATE	STATUS	BY
A	FOR DISCUSSION	11/02/2026	DRAFT	LD

TEKTUS CONSULTANTS

CLIENT: STEVENSON

PROJECT: **CLEVEDON QUARRY**

STATUS: **FOR INFORMATION**

DRAWING NAME: **PROPOSED CHANGE IN CATCHMENT AREA**

PROJECT NO:	DRAWING NO:	REVISION:
T25175	**450**	A

DRAWN:	LD	SCALE: 1:7500 @A3
REVIEWED:	MW	DATE: 16/06/2026
APPROVED:	MW	

Appendix N Assessment against offsetting and compensation principles

Appendix N Table 1: Assessment of terrestrial offset proposal against Appendix 3 of NPS-IB: Principles for biodiversity offsetting

Principle	Assessment
1 **Adherence to effects management hierarchy**	The effects management hierarchy has been addressed as follows: • Avoid and minimise: – Worked through multiple design iterations to avoid best-quality habitat and minimise impacts on other native habitats. • Remedy – A Quarry Rehabilitation Plan will be developed towards the end of the quarry's life. This will require the establishment of approximately 9.5 ha of native vegetation on quarry benches. It was not possible to completely avoid, minimise, or remedy the loss of regenerating tree fern/broadleaf forest and therefore biodiversity offset is proposed.
2 **Appropriateness of offsetting**	Biodiversity offset is considered appropriate because: • The vegetation being lost is a regenerating ecosystem dominated by pioneer species and is not considered irreplaceable or vulnerable. • The effects on indigenous biodiversity associated with the removal of a regenerating ecosystem are well understood. The effects are irreversible at the point of impact and therefore offset is proposed. • Restoration planting is an established method for offsetting the loss of native vegetation. Gains will be achieved within an acceptable timeframe and it is anticipated restoration targets will be met prior to impact. Monitoring of planting will be undertaken with adaptive management approaches in place to ensure gains are attained.
3 **Net gain**	The terrestrial offset planting will form part of a catchment-scale effects management package comprising over 50 ha of planting. Overall, a Net Gain is anticipated when the effects management package is completed.
4 **Additionality**	The offset planting will be undertaken on land that is currently used for production forestry and retiring this land and converting it to restoration planting is therefore considered to meet the additionality requirement.
5 **Leakage**	Biodiversity offset implementation will not displace harm to indigenous biodiversity in the same or any other location.

Principle	Assessment
6 Long-term outcomes	The restoration planting area will be protected in perpetuity. Restoration plantings will be maintained for at least 5 years and monitored for 25 years until biodiversity offset targets have been met.
7 **Landscape context**	Biodiversity offsetting is being undertaken immediately adjacent to the point of impact. The full effects management package will provide connectivity between the Wairoa River and the Hunua Ranges and will link two native forest/treeland remnants.
8 **Time lags**	The bulk of the vegetation clearance requiring offset is not anticipated to start until at least 20 years after consent is granted. 6 ha of the terrestrial offsetting will commence shortly after consent is granted with the remainder commencing approximately 10 years later once the overburden is full. Calculated gains are anticipated to be achieved within a maximum of 25 years.
9 **Science and mātauranga Māori**	Biodiversity offset planting palettes and maintenance plans will be designed using best-practice methods. Plant selection will follow *Te Haumanu Taiao: Restoring the natural environment in Tāmaki Makaurau* guidelines, which were developed in collaboration with Ngā Iwi Mana Whenua o Tāmaki Makaurau to ensure restoration meets scientific and mātauranga Māori requirements.
10 **Tangata whenua and stakeholder participation**	The proposed catchment-scale effects management package is supported by local iwi. In addition to providing a link between the Wairoa River and the Hunua Ranges, the effects management approach will significantly reduce the amount of sediment entering the Wairoa River on an ongoing basis from the Stream 3 catchment, particularly the significant sediment pulses caused by pine harvesting every 25-30 years.
11 **Transparency**	The BOAM calculations are presented within the Ecological Impact Assessment. Annual monitoring of planting success will be undertaken and reported to Council for 5 years. Reports will be issued to Council after each BOAM monitoring round (likely 5-yearly for 25 years)

Appendix N Table 2: assessment of freshwater offset proposal against Appendix 6 of NPS-FM: Principles for aquatic offsetting

Principle	Assessment
1 **Adherence to effects management hierarchy**	In respect of the loss of stream habitat through direct removal of stream reaches, the effects management hierarchy has been addressed as follows: • Avoid and minimise: – Worked through multiple design iterations to minimise impacts on freshwater ecosystems including avoidance of higher value streams where practicable. – Provision of flow augmentation where practicable to reduce potential for stream habitat loss in areas where catchments are reduced. – It was not possible to further avoid, minimise, or remedy the loss of streams and stream surface flow effects; therefore a freshwater offset and compensation package is proposed.
2 **Appropriateness of the aquatic offsetting**	The proposed freshwater offsetting is considered appropriate because: • The ecological values of the Stream 1, 2, 2a and 3 catchments are not considered irreplaceable or vulnerable; • The effects on the stream reaches to be removed within the footprint are well-understood. These effects are irreversible at the point of impact and therefore offset is proposed. For the remaining proportion of the effects after offset has been applied, freshwater compensation is proposed. • Riparian planting of degraded streams is an established method for offsetting the loss of freshwater ecological values, such as through stream reclamation. Gains will be achieved within an acceptable timeframe and it is anticipated restoration targets will be met prior to impact. Monitoring of planting will be undertaken with adaptive management approaches in place to ensure gains are attained.
3 **No net loss and preferably a net gain**	The ECR/SEV calculations have been used to demonstrate the proportion of residual stream effects that are offset by the Stream 3 riparian offset planting. The offsetting results in at least no net loss of ecological function (measured through the SEV) for 38% of the residual stream effects. The remaining proportion of residual stream effects are addressed through the freshwater compensation component of the package.
4 **Additionality**	The riparian planting and protection in perpetuity on the private landholdings would not occur in the absence of this

Principle	Assessment
	project. There are no statutory requirements to restore streams at the offset site, nor any other planned or funded restoration activities
5 **Leakage**	The proposed freshwater offset and implementation avoids displacing harm to other locations (including harm to existing biodiversity at the offset site).
6 Long-term outcomes	The restoration planting area will be protected in perpetuity. Restoration plantings will be maintained for at least 5 years and monitored for until it is confirmed plantings are on track to meet the targets set in the SEV/ECR calculations. If it is determined that the plantings will not meet the targets set in the SEV/ECR calculations within the expected timeframes, adaptive management measures will be implemented.
7 **Landscape context**	Freshwater offsetting is being undertaken immediately adjacent to the points of impact, within streams of similar order and topography and within the same catchment. The full effects management package will provide a connected riparian corridor between the headwaters of the Stream 3 tributaries, down to the Stream 3 main channel and through to its confluence to the Wairoa River.
8 **Time lags**	Freshwater offset planting is proposed to be implemented prior to the removal of streams and upstream contributing catchment area within the quarry footprint. The majority of these impacts will occur more than 10 years following granting of consent, and some up to 50 years later. Thus, time lags will be minimised as far as possible. An ECR multiplier has been applied where time lags are anticipated.
9 **Science and mātauranga Māori**	An accepted offset model (ECR) was used in the quantification of the benefits of the offset component of the freshwater offset/ compensation package.
10 **Tangata whenua and stakeholder participation**	The proposed catchment-scale effects management package is supported by tangata whenua. In addition to providing a link between the Wairoa River and the Hunua Ranges, the effects management approach will significantly reduce the amount of sediment entering the Wairoa River on an ongoing basis from the Stream 3 catchment, particularly the significant sediment pulses caused by pine harvesting every 25-30 years.
11 **Transparency**	The SEV/ECR calculations are presented within the Ecological Impact Assessment and demonstrate the proportion of residual freshwater effects that can be offset by the proposed quantum offset planting. Annual reports will be issued to Council for 5 years as restoration plantings establish. Reports will be issued to Council after

Principle	Assessment
	each planting monitoring round (likely 5-yearly) until restoration targets are met (anticipated to be 25 years).

Appendix N Table 3: assessment of freshwater compensation proposal against Appendix 7 of NPS-FM: Principles for aquatic compensation

Principle	Assessment
1 **Adherence to effects management hierarchy**	In respect of the loss of stream habitat through direct removal of stream reaches or indirect stream loss through reduction in catchment size, the effects management hierarchy has been addressed as follows: • Avoid and minimise: – Worked through multiple design iterations to minimise impacts on freshwater ecosystems including avoidance of higher value streams where practicable. – Provision of flow augmentation where practicable to reduce potential for stream habitat loss in areas where catchments are reduced. • Offset: – Offset measures will be implemented across all suitable streams within the Stream 3 catchment, to offset 1,277 m (737 m^2 streambed area) of the total 3,925 m (1,925 m^2) loss of freshwater ecological values. The stream length lost to length offset ratio will exceed the minimum 1:1 requirement. The quantum of streambed area available for offset within the Stream 3 catchment will offset 38% of the residual effects. Freshwater compensation is proposed for the remaining proportion, which will involve further planting within the Stream 3 catchment to extend the riparian buffer provided by the freshwater offset planting proposed, including up to the top of the ridge in the upper half of the catchment. In addition, an existing area of native vegetation which surrounds 392 m of the Stream 3 main channel and one of its tributaries will be protected.
a. **Appropriateness of aquatic compensation**	The proposed freshwater compensation is considered appropriate because: • The ecological values of the Stream 1, 2, 2a and 3 catchments are not considered irreplaceable or vulnerable; • The effects on the stream reaches to be removed within the footprint and that will be affected by reduced upstream catchment area are well-understood. These effects are irreversible at the point of impact and therefore compensation is proposed after offset opportunities within the Stream 3 catchment have been utilised. • Riparian planting of stream catchments contributes to overall improved aquatic health through, for example, reduction in sediment contributions. Gains will be achieved within an acceptable timeframe and it is anticipated restoration

Principle	Assessment
	targets will be met prior to impact. Monitoring of planting will be undertaken with adaptive management approaches in place to ensure gains are attained.
2 **Scale of biodiversity compensation**	The freshwater compensation measures will provide positive effects on freshwater ecological values within the Stream 3 catchment by: • buffering the stream riparian margins proposed for planting through the offsetting measures, reducing edge effects and resilience and effectiveness of the offset riparian planting, and further strengthening riparian benefits to the streams such as shading and temperature control to the streams; • connecting areas of terrestrial offset planting and existing native vegetation within the upper half of the catchment, so that a river to ridge planted catchment is created, providing further protection to the streams within the catchment and benefits downstream to the Wairoa River, by retiring this part of the catchment from forestry and reducing fine sediment inputs to the streams; and • applying the SEV/ECR methodology to assist in determining a scale of freshwater compensation that will outweigh the adverse effects.
3 **Additionality**	The freshwater compensation planting and protection in perpetuity on the private landholdings would not occur in the absence of this project. There are no statutory requirements to restore streams at the offset site, nor any other planned or funded restoration activities
4 **Leakage**	The proposed freshwater compensation and implementation avoids displacing harm to other locations (including harm to existing biodiversity at the freshwater compensation site).
5 **Long-term outcomes**	The restoration planting area will be protected in perpetuity. Restoration plantings will be maintained for at least 5 years and monitored until it is confirmed plantings are on track to meet the restoration targets.
6 **Landscape context**	Freshwater compensation measures are being undertaken immediately adjacent to the points of impact, within streams of similar order and topography and within the same catchment. Freshwater compensation planting will be located adjacent to both the freshwater offset and terrestrial offset plantings. The full effects management package will provide a connected riparian corridor between the headwaters of the Stream 3 tributaries, down to the Stream 3 main channel and through to its confluence to the Wairoa River.

Principle	Assessment
7 **Time lags**	Freshwater compensation planting is proposed to be implemented prior to the removal of streams and upstream contributing catchment area within the quarry footprint. The majority of these impacts will occur more than 10 years following granting of consent, and some up to 50 years later. Thus time lags will be minimised as far as possible.
8 **Trading up**	It is acknowledged that the loss of stream habitat value will be replaced by a non like-for-like trade, being the provision of terrestrial planting. In determining the appropriateness of this, the ecological values of the Stream 1, 2, 2a and 3 catchments are not considered irreplaceable or vulnerable. The proposed freshwater compensation measures will complement the freshwater and terrestrial offset planting, so that the current forestry land use within the Stream 3 catchment is predominantly retired and planted, from the Stream 3 tributaries, down to the Stream 3 main channel and through to its confluence to the Wairoa River. While a terrestrial planting exercise, there are benefits to aquatic systems.
9 **Financial contributions**	Financial contribution does not form part of the proposed compensation measures. The compensation component of the package comprises catchment planting and protection of areas of existing vegetation within the Stream 3 catchment, so that biodiversity gains are realised as close to the impact site as possible.
10 **Science and mātauranga Māori**	There is no methodology for robustly comparing losses and gains for different types of biodiversity (ie riparian planting vs planting away from the 20 m riparian edge). Notwithstanding this, the approach to quantifying the compensation proposed is clearly articulated.
11 **Tangata whenua and stakeholder participation**	The proposed catchment-scale effects management package is supported by tangata whenua. In addition to providing a link between the Wairoa River and the Hunua Ranges, the effects management approach will significantly reduce the amount of sediment entering the Wairoa River on an ongoing basis from the Stream 3 catchment, particularly the significant sediment pulses caused by pine harvesting every 25-30 years.
12 **Transparency:** The design and implementation of biodiversity compensation, and communication of its results to the public, is undertaken in a transparent and timely manner.	The SEV/ECR calculations are presented within the Ecological Impact Assessment and demonstrate the proportion of residual freshwater effects that can be offset by the proposed quantum offset planting, and therefore the remaining proportion of residual freshwater effects that are to be addressed through freshwater compensation. The SEV/ECR method has been applied to as a starting point in

Principle	Assessment
	quantifying an appropriate quantum of freshwater compensation planting. The calculations are provided in the EcIA. The SEV/ECR calculations are presented within the Ecological Impact Assessment and demonstrate the proportion of residual freshwater effects that can be offset by the proposed quantum offset planting. Annual reports will be issued to Council for 5 years as restoration plantings establish. Reports will be issued to Council after each planting monitoring round (likely 5-yearly) until restoration targets are met (anticipated to be 25 years).



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